

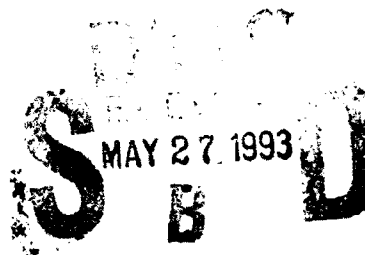
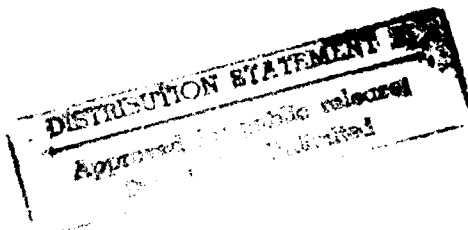
AD-A265 025



FINAL REPORT  
JULY 1992

REPORT NO. 92-23

TESTING OF  
LOCALLY-FABRICATED  
TIEDOWN FITTINGS



Prepared for:  
U.S. Army Defense Ammunition  
Center and School  
ATTN: SMCAC-DET  
Savanna, IL 61074-9639

Distribution Unlimited

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VALIDATION ENGINEERING DIVISION  
SAVANNA, ILLINOIS 61074-9639

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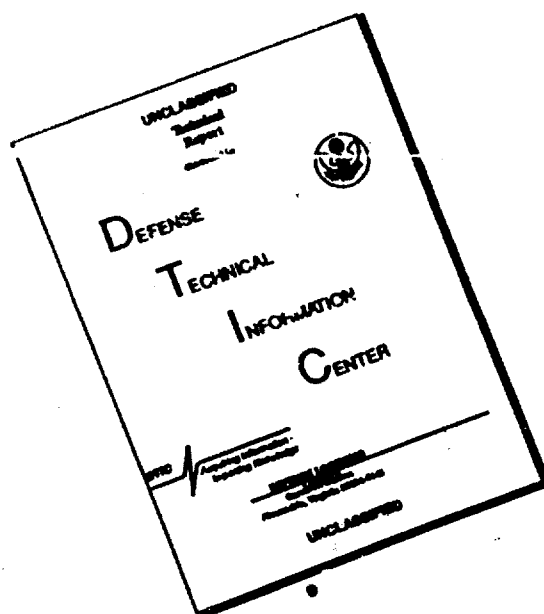
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<p>During the Ammunition Hotwash Conference, 26 March 1991, held at Ramstem Air Base, GE. it was pointed out that the "Mickey Mouse" and "Bigfoot" tiedown fittings were neither affordable nor available for transportation companies. These fittings are used to tiedown loads on M871 and M872 trailers with web straps. As a result, the transportation companies resorted to fabricating their own fittings.</p> <p>As a result of the field expedient locally-fabricated tiedown fittings collected from Southwest Asia (SWA) support, the U.S. Army Defense Ammunition Center and School (USADACS), Transportation Engineering Division (SMCAC-DET), requested the USADACS, Validation Engineering Division (SMCAC-DEV), test, measure and draw each type of fitting. Each fitting was pull tested to determine its maximum working strength. (continued)</p>					
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19. Abstract (continued)

Based on MIL-STD-209H, Military Standard Slings and Tiedown Provisions for Lifting and Tying Down Military Equipment, these fittings are class 4 and must hold a 10,000-pound load without deformation or breakage. As a result of testing, all tiedown fixtures either broke or were deformed before reaching the 10,000-pound pull requirement.

Form 3

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U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL  
VALIDATION ENGINEERING DIVISION  
SAVANNA, IL 61074-9639

REPORT NUMBER 92-23

TESTING OF LOCALLY-FABRICATED TIEDOWN FITTINGS

SEPTEMBER 1992

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## PART 1

### INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center and School (USADACS), Validation Engineering Division (SMCAC-DEV), was tasked by USADACS, Transportation Engineering Division (SMCAC-DET), to test locally-fabricated tiedown fittings that were collected from samples used to transport ammunition over European highways to support Operations Desert Shield/Desert Storm. In order to accomplish their mission, units resorted to having local welding and fabrication shops construct a tiedown provision for immediate use and at minimal expense. The delay/nonavailability and higher cost in obtaining the tie-downs through the government supply system makes local fabrication of the provisions the only option for the units.

B. AUTHORITY. This test was conducted IAW mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, IL.

C. OBJECTIVE. The objective of these tests was to assess the capability of the locally-fabricated tiedown fittings to meet U.S. Army (USA) functional and operational requirements of MIL-STD-209H.

D. CONCLUSION. Although test sample no. 1 was found to have the greatest tensile strength of the six different types of samples, testing also caused significant damage to it. This report also establishes that there was substantial weld failure experienced throughout the testing. It should be noted that most of the bending and deformation was due to the weaknesses of the materials used to form these tiedown fittings. Thus, this report concludes that all six of the locally-fabricated tiedown fittings that did not damage retention test fixtures, failed at less than 10,000 pounds.

E. RECOMMENDATION. Some of the fitting designs could be salvaged by using stronger materials to replace those used in these test samples. There were also many weld failures experienced during the testing. The design should be changed placing less stress on welds while using heavier materials. This would resolve the problems and result in an acceptable product. Based upon the test results contained herein, drawings detailing tiedown fitting fabrication should be developed for test samples 4 and 5, limitations be stated thereon, and a memorandum of approval/results be provided to the 200th Theater Army Materiel Management Center (TAMMC) for future European theater use and application.



PART 2

JULY 1992

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## PART 3

### TEST PROCEDURES

A. Test Requirements. MIL-STD-209H, Military Standard Slings and Tiedown Provisions for Lifting and Tying Down Military Equipment, identifies these locally-fabricated tiedown fittings as class 4 cargo tiedown provisions. The load rating for a class 4 fitting is dependent on the load capacity of the hauling vehicle. The "Mickey Mouse" fitting, which these devices are intended to be used in place of, was mounted on vehicles with more than 10,000-pound load-carrying capacity. Thus, these units are required to withstand 10,000 pounds without deforming with tensile loads applied vertically, horizontally, and laterally. For this testing performed in the laboratory, all fittings were pulled vertically.

B. Equipment Setup. The Ormond Tension-Compression tester has a 5- by 5-foot flat plate test surface with threaded holes in the center of its top and bottom sections, used for mounting test fixtures. A 50,000-pound load cell was mounted to the fixed bottom plate with the sample test fitting above it. An eyebolt was then mounted to the top plate with a clevis that provided an interface to attach to the test samples. There also was a displacement gauge mounted to the fixed table of the tester, which provided a measure of the separation between the plates. The load cell and displacement gauge outputs were recorded electronically.

C. Test Procedures.

1. Mount the test sample in the test fixture.
2. Start the data recording equipment.
3. Slowly apply tension to the test sample until failure or until the tension exceeds 15,000 pounds, the ultimate load.
4. Save the recorded data and note mode of sample failure.

## PART 4

### TEST EQUIPMENT

#### A. COMPRESSION TESTER.

- a. Manufacturer: Ormond Manufacturing
- b. Platform: 60 inches by 60 inches
- c. Compression Limit: 50,000 pounds
- d. Tension Limit: 50,000 pounds

#### B. LOAD CELL.

- a. Manufacturer: Toroid Corporation
- b. Capacity: 50,000 pounds
- c. Model: 45 132 BKF
- d. Serial Number: 44755

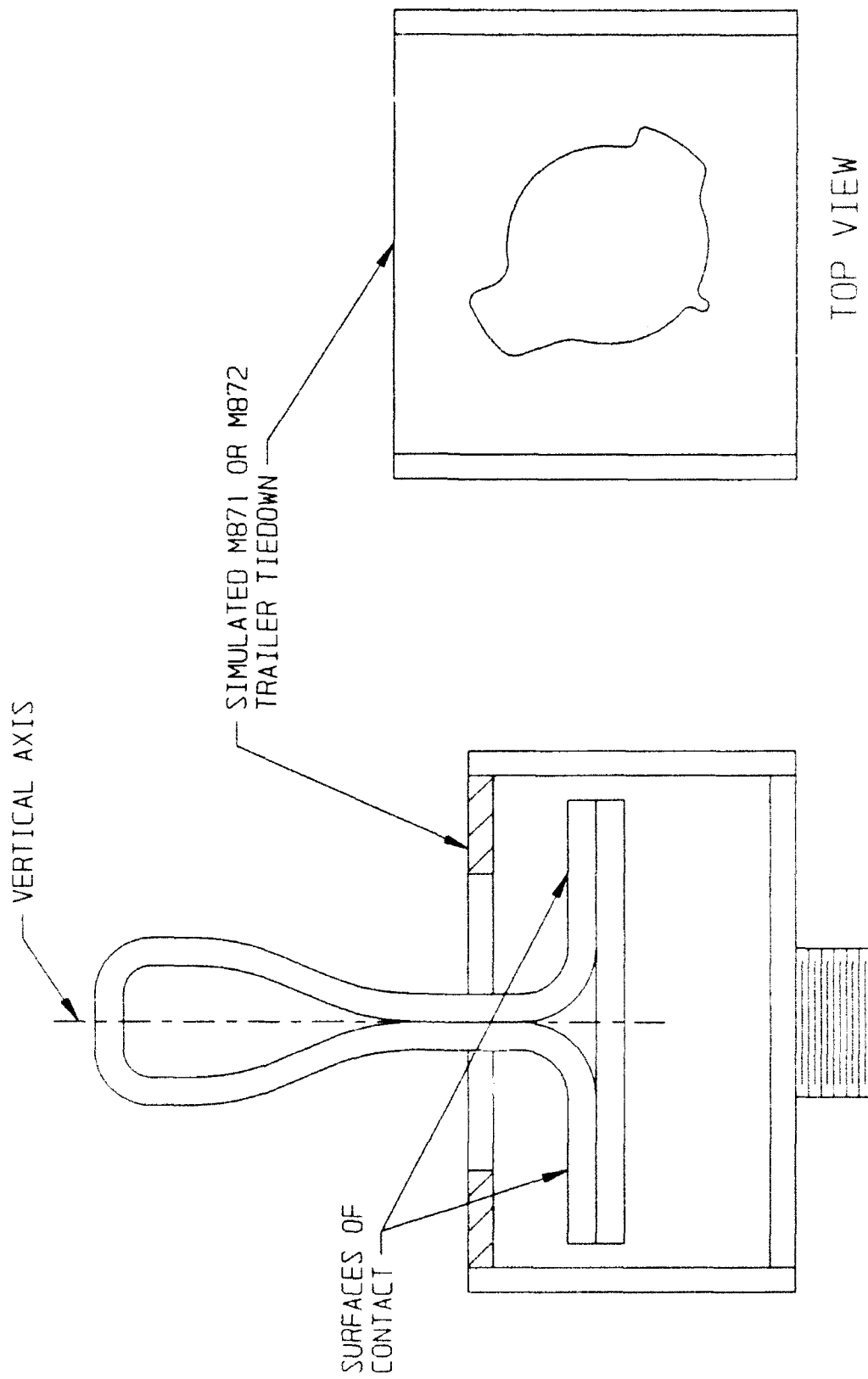
#### C. PORTABLE DATA ACQUISITION SYSTEM.

- a. Manufacturer: Pacific Instruments
- b. Model: 5700

#### D. DISPLACEMENT GAGE.

- a. Manufacturer: Celesco Incorporated
- b. Model: PT-101-20A
- c. Serial Number: 0953822

GENERAL TEST SET-UP OF LOCALLY FABRICATED TIEDOWN FITTINGS



## PART 5

### TEST SETUP

The Toroid Corporation load cell was secured to the Ormond Manufacturing Compression/Tension tester fixed platform with a threaded coupler. The locally-fabricated trailer side rail simulator was then screwed into the top of the load cell. A threaded eye bolt was attached to the movable compression/tension tester platform.

The test couple was placed into the simulated trailer tiedown fitting and secured to the eye bolt with a bolt-type clevis.

A displacement gauge was connected between the compression/tension tester platform.

Both transducers were connected to different channels on data acquisition systems.

Once a test sample was secured in the test fixture, and the slack was taken out of the coupling, the data acquisition equipment was started and displacement and applied load was recorded for the duration of the test. The results were then graphed.

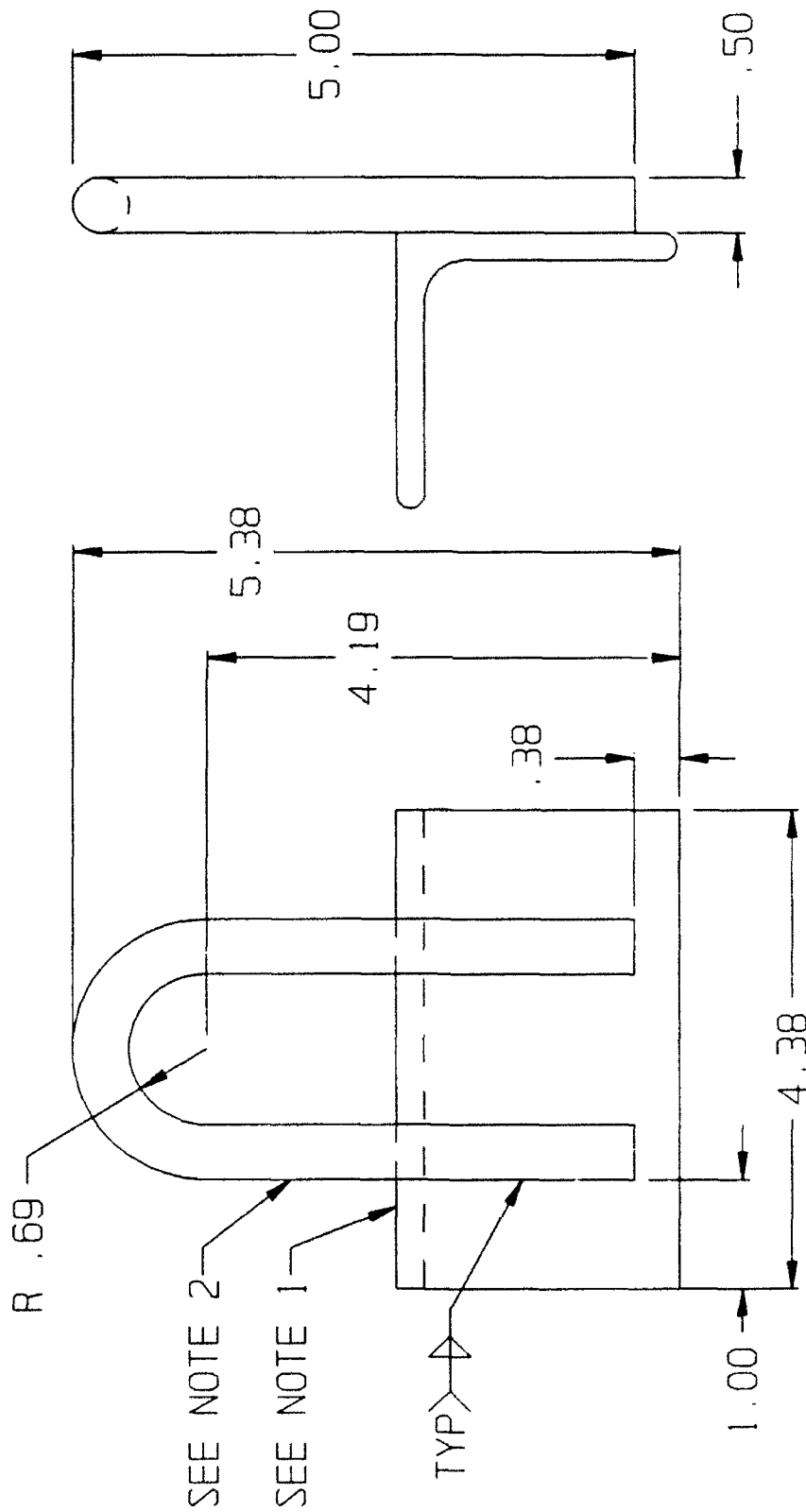
## PART 6

### TEST DATA AND RESULTS

#### TEST SAMPLE NO. 1:

Explanation of Failure. Test sample no. 1 was the strongest of the six different designs, yielding at 13,110 pounds. Due to the design of the tiedown fitting, the outside corner of the steel angle piece of the fitting damaged the simulated trailer side rail. This test sample was deformed in such a way that the rod forming the tiedown eye tore away from the steel angle piece and out of its weld until it had been bent a total of 62 degrees away from its original vertical position (see photo).

# LOCALLY FABRICATED TIEDOWN FITTING #1



## NOTE:

1. STEEL, STRUCTURAL, ANGLE, L2-1/2" X 2-1/2" X 1/4" X 4-3/8" LONG PER ASTM A36, FSC 9520
2. STEEL, BAR, ROUND, HOT ROLLED, 1/2" DIA X 10-1/2" LONG 1018, PER ASTM A36, FSC 9520
3. ALL DIMENSIONS ARE IN INCHES

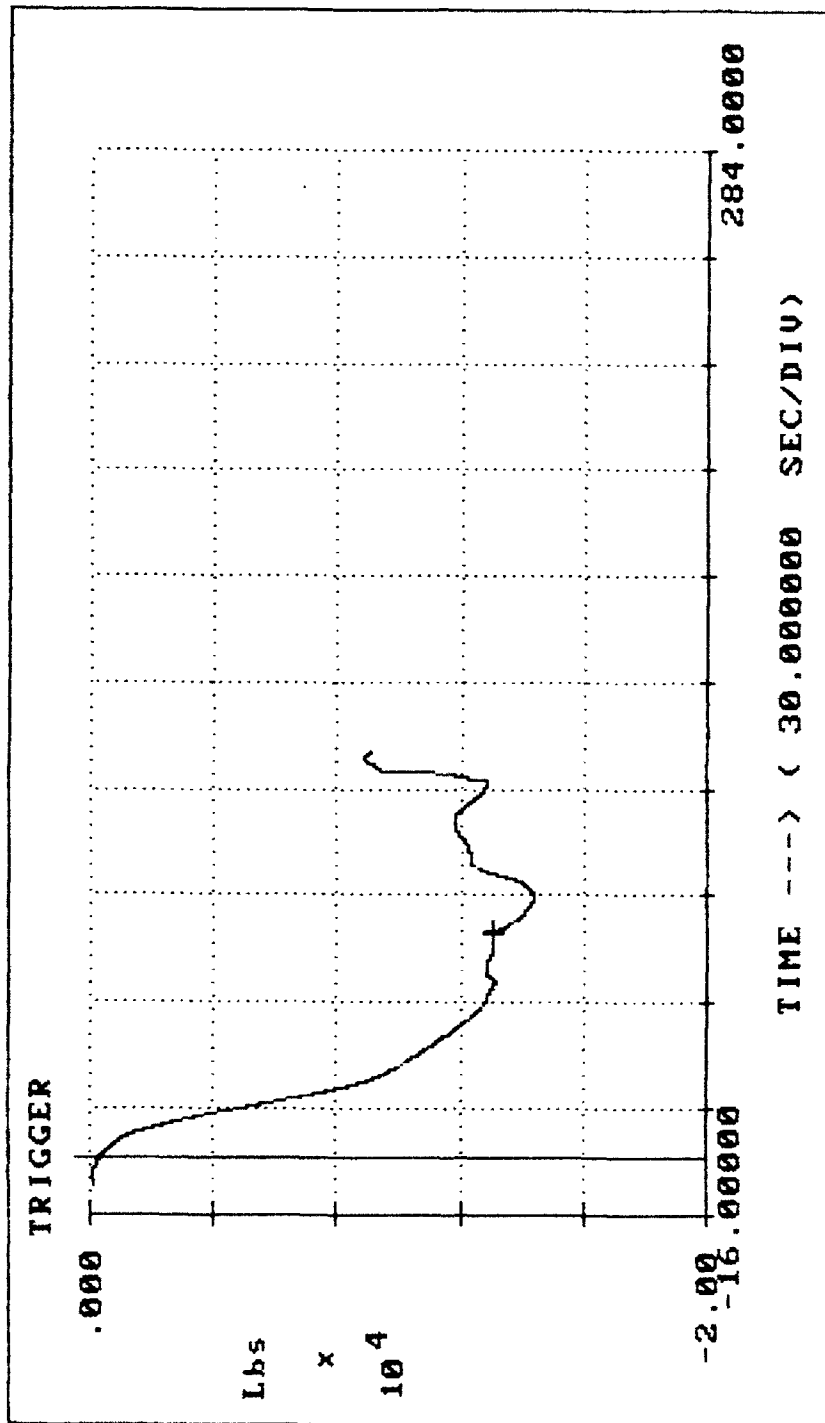
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TITLE  
TESTING OF LOCALLY  
FABRICATED TIEDOWN  
FITTINGS, FITTING #1

DATE

92-023-0-T00074

VALIDATION ENGINEERING DIVISION SHEET 1 OF 1



LOAD1 TRIGGER OCCURRED 106.188500 SECONDS AFTER START  
Hook 1

LEGEND:  
LOAD1

Time= 63.202007 Lbs =-13110.351563



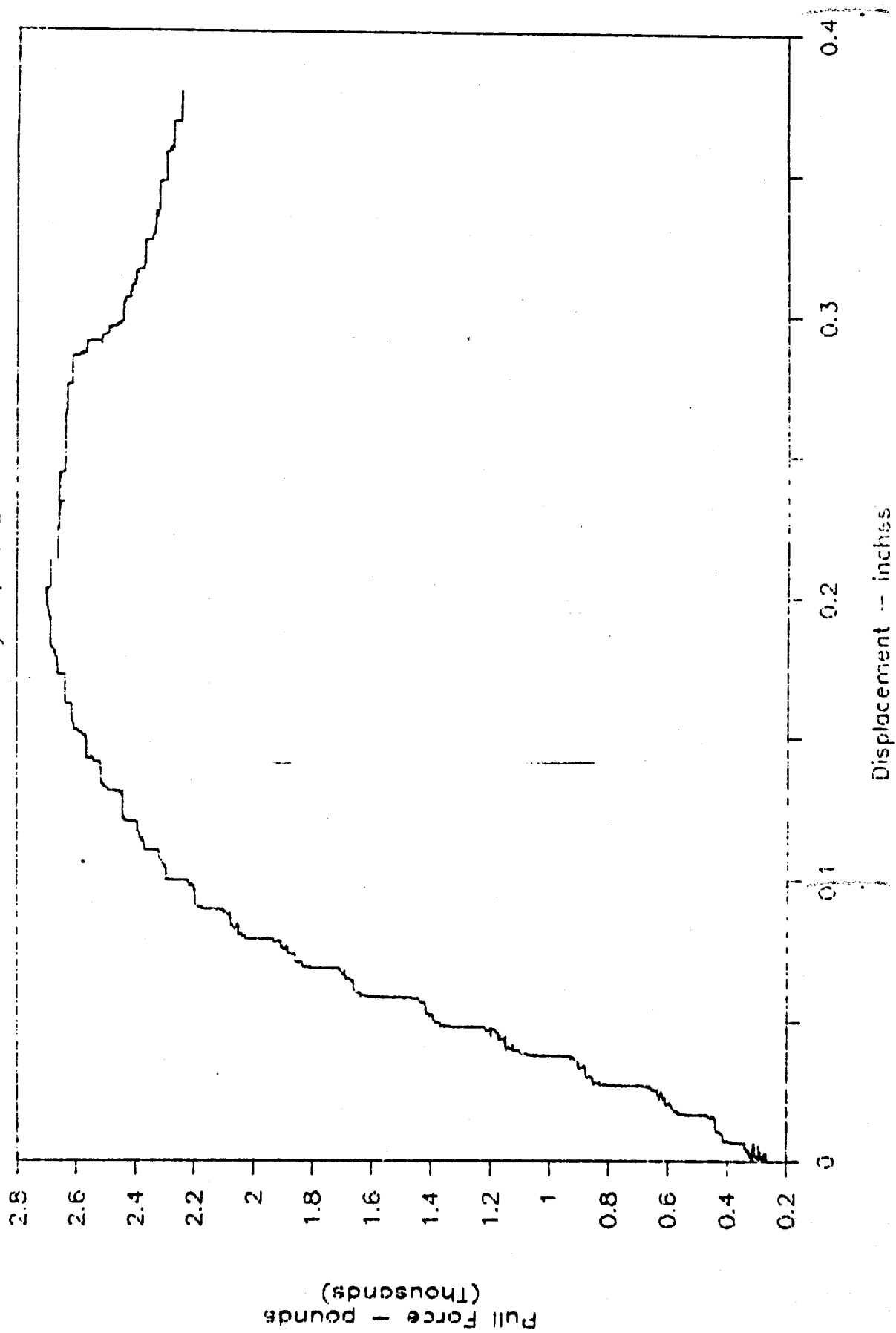
TEST SAMPLE NO. 2A:

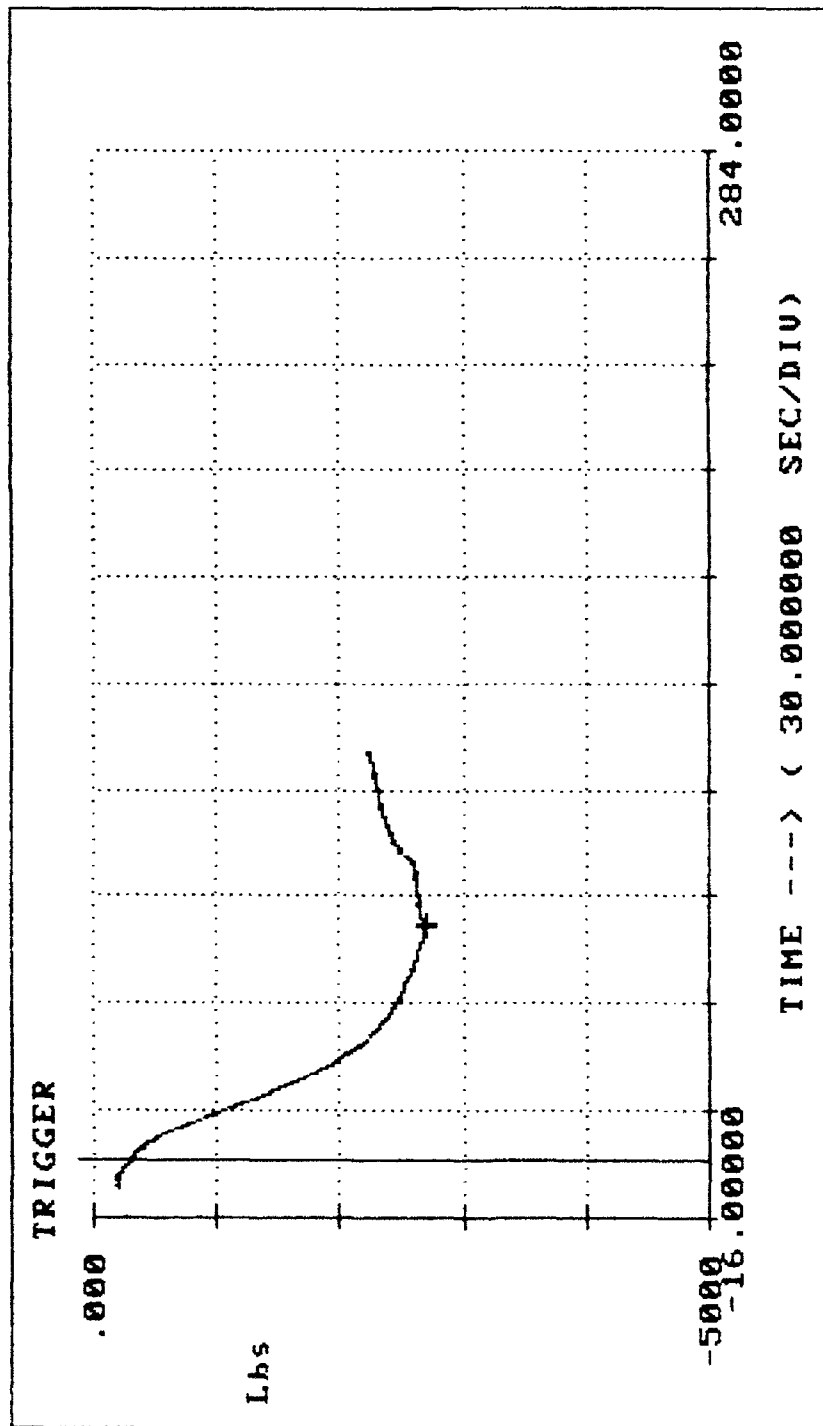
Explanation of Failure. Test sample no. 2a was placed so that its points of contact in the simulated trailer side rail were at distances of 2 inches from the vertical axis of the tiedown. This simulated the weakest possible orientation. This test sample reached a load of 2,710 pounds when the welds that hold the bottom rod to the rest of the tiedown fitting began to break, while the rod itself was bent to an angle of 8 degrees from horizontal (see photo).



# Tiedown Sample #2a

Tested July 23, 1992





LOAD1 TRIGGER OCCURRED 50.607000 SECONDS AFTER START

Hook 2a

LEGEND:

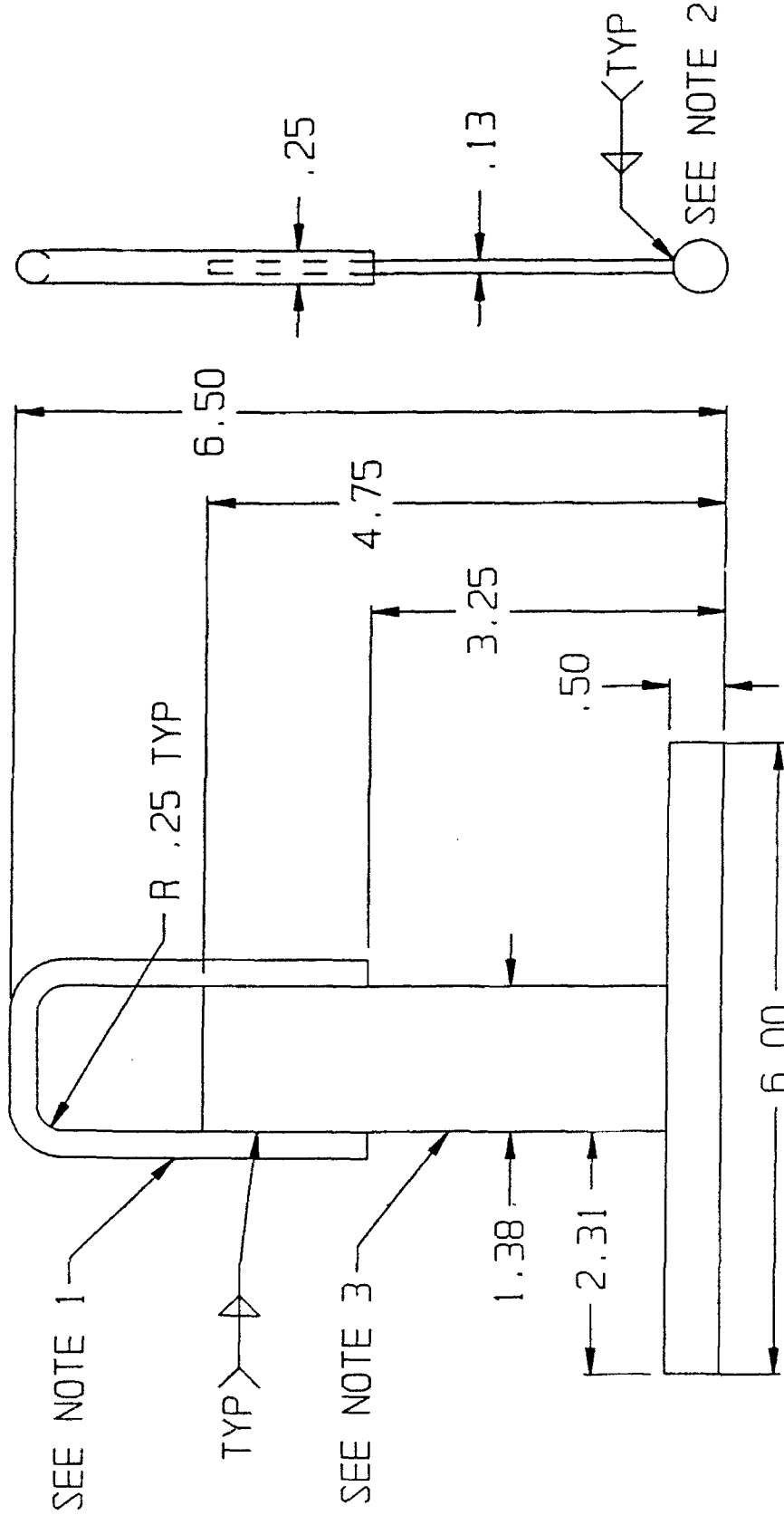
LOAD1

Time= 65.402504 Lbs =-2709.960938

TEST SAMPLE NO. 2B:

Explanation of Failure. Test sample no. 2b was placed so that its points of contact were located at distances of 1-1/2 inches from its vertical axis. This simulated a stronger orientation than test sample no. 2a experienced. Test sample no. 2b yielded at 4,200 pounds and deformed in a similar manner to test sample no. 2a. It experienced bending in the lower bar of 5 degrees from its original horizontal position and failure in the welds holding the lower bar to the rest of the fitting (see photo).

# LOCALLY FABRICATED TIEDOWN FITTING #2



## NOTE:

1. STEEL, BAR, ROUND, HOT ROLLED, 1/4" DIA X 7-1/2" LONG  
1018, PER ASTM A36 FSC 9520
2. STEEL, BAR, ROUND, HOT ROLLED, 1/2" DIA X 6" LONG  
1018, PER ASTM A36, FSC 9520
3. STEEL, BAR, STRIP, HOT ROLLED, 1/8" X 1-3/8" WIDE X 4-1/4" LONG
4. ALL DIMENSIONS ARE IN INCHES

FOR INFORMATION ONLY

TESTING OF LOCALLY  
FABRICATED TIEDOWN  
FITTINGS, FITTING #2

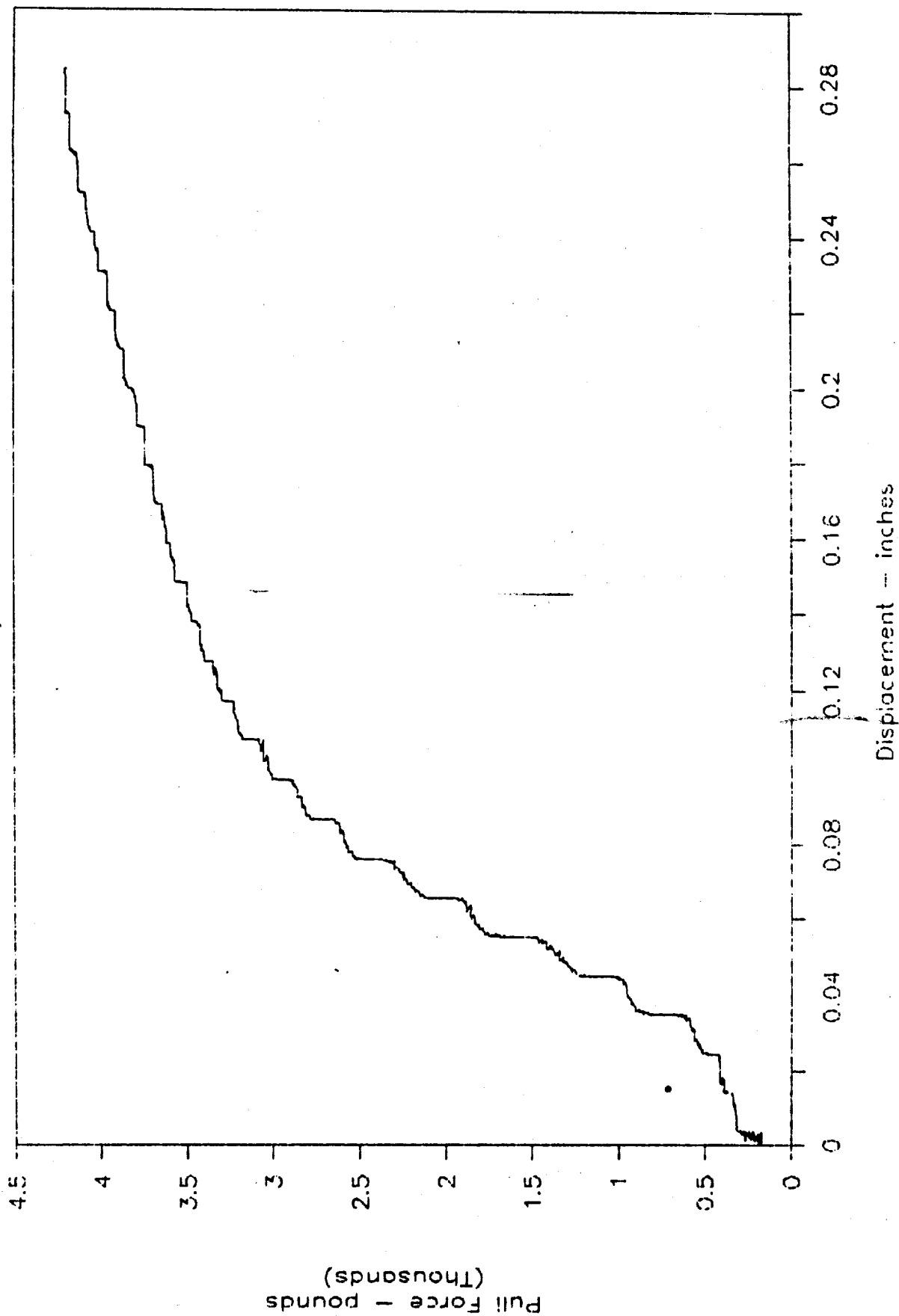
FIG. #

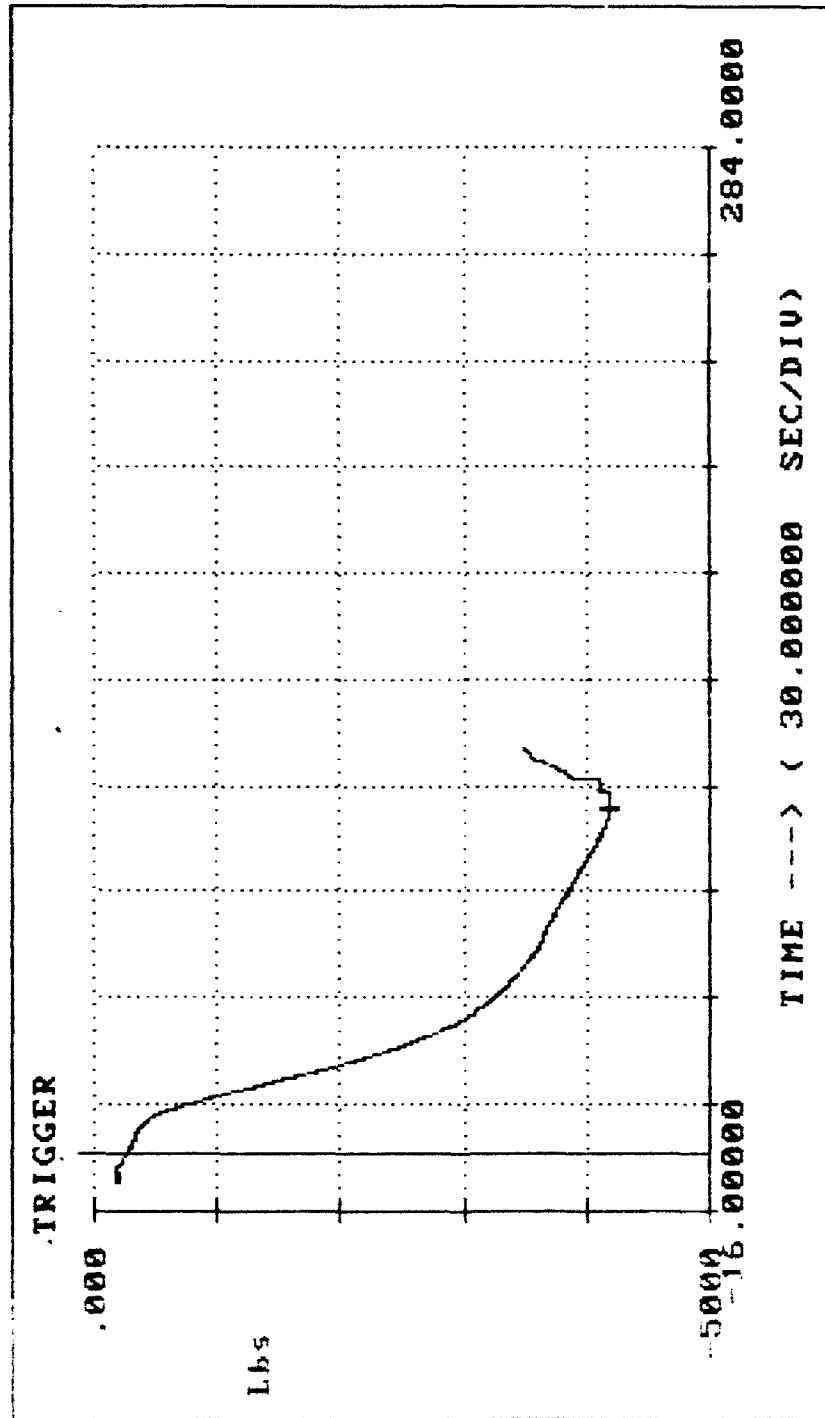
92-023-0-T00075

VALIDATION ENGINEERING DIVISION SHEET 1 OF 1

# Tiedown Sample #2b

Tested July 23, 1992





Time = 96.861511 Lbs = 4199.218750

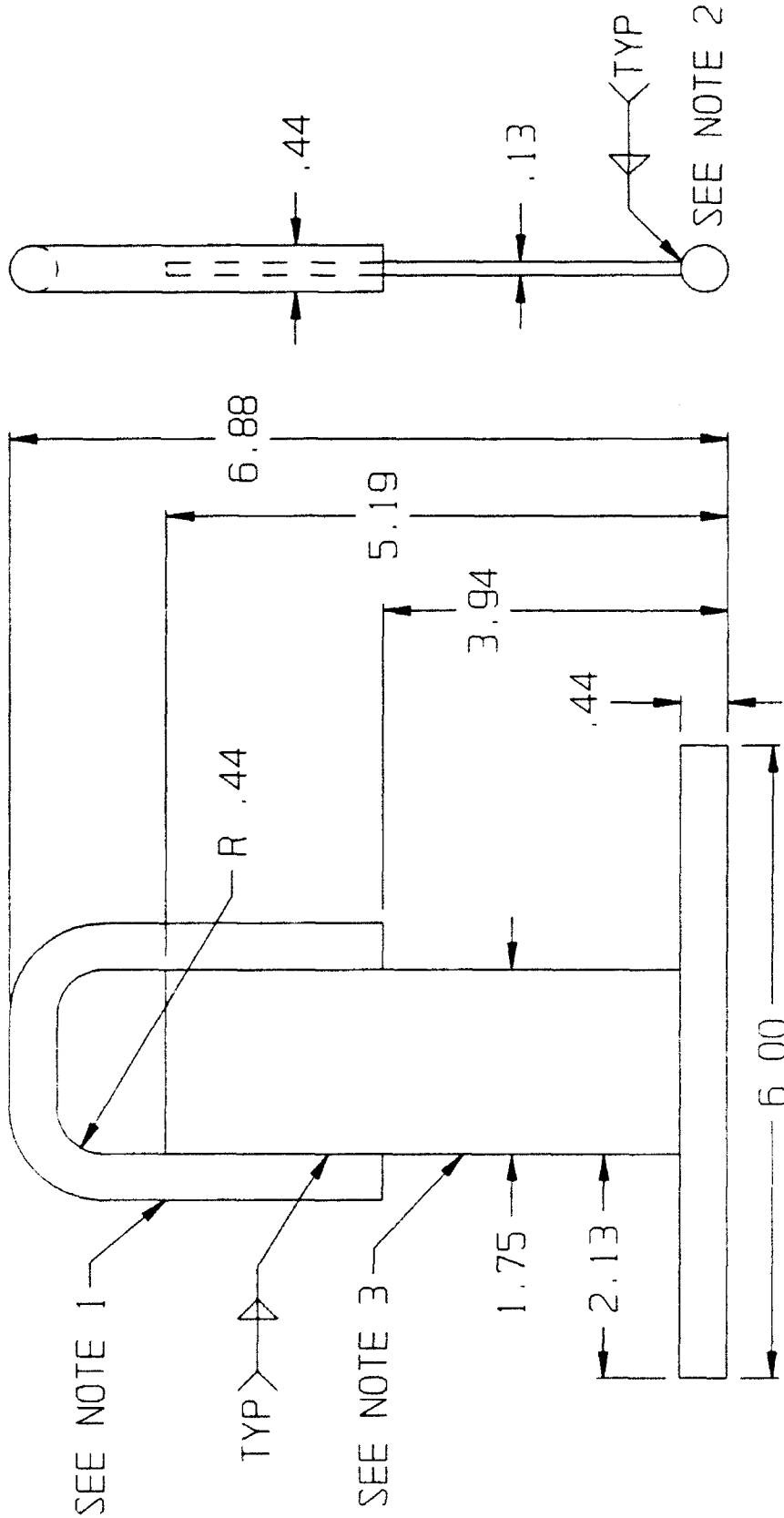


TEST SAMPLE NO. 3:

Explanation of Failure. Test sample no. 3 was placed in the trailer side rail fixture so that the points of contact were at distances of 2 inches from its vertical axis. This simulated the weakest orientation possible.

When the load on test sample no. 3 reached 3,735 pounds the welds holding the bottom rod to the rest of the fitting began to break, while the rod itself was bent to an angle of 15 degrees below its original horizontal position (see photo).

# LOCALLY FABRICATED TIEDOWN FITTING #3



## NOTE

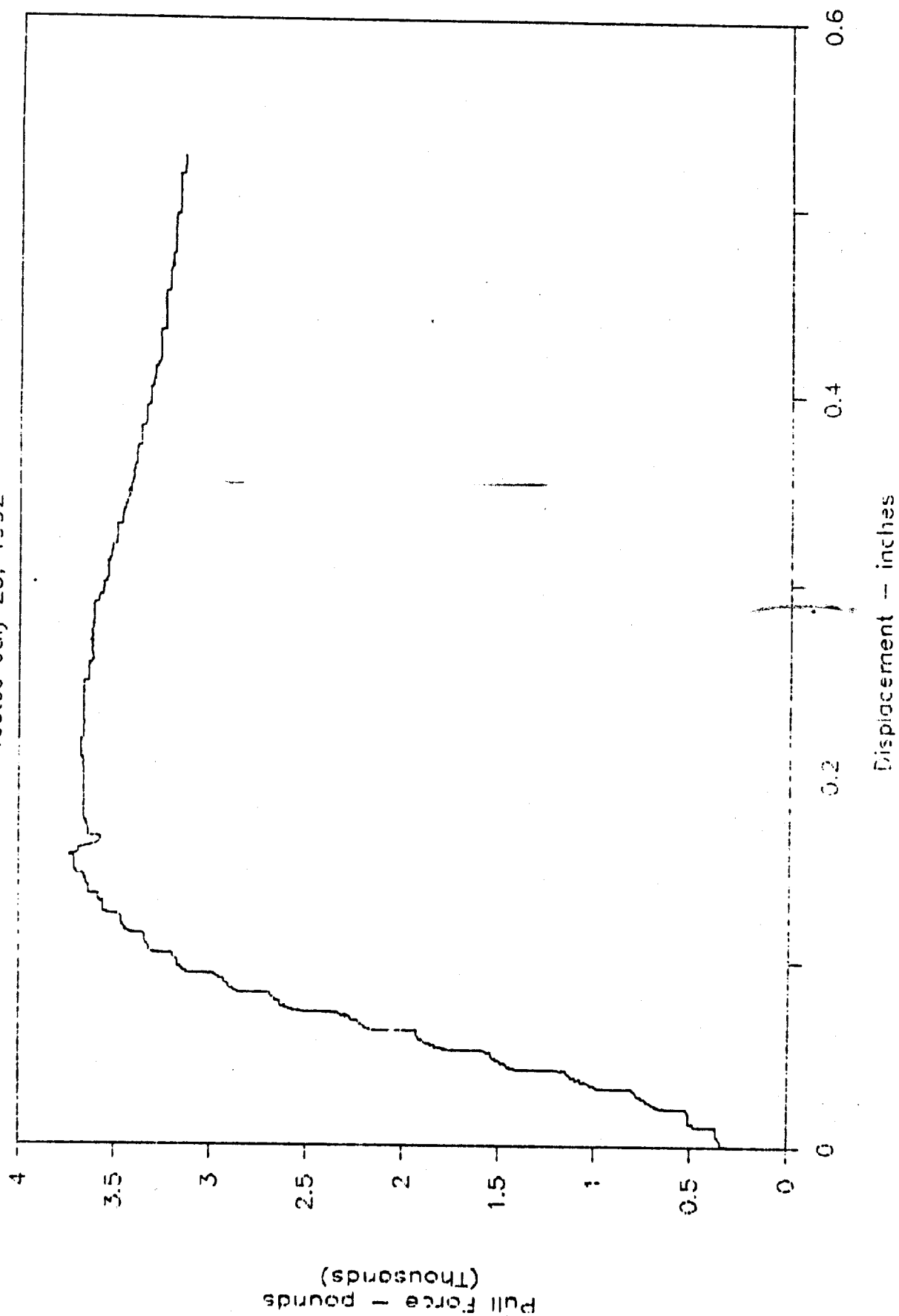
1. STEEL, BAR, ROUND, HOT ROLLED, 7/16" DIA X 7-1/2" LONG  
1018, PER ASTM A36 FSC 9520
2. STEEL, BAR, ROUND, HOT ROLLED, 7/16" DIA X 6" LONG  
1018, PER ASTM A36, FSC 9520
3. STEEL, BAR, STRIP, HOT ROLLED, 1/8" X 1-3/4" WIDE X 4-3/4" LONG  
4. ALL DIMENSIONS ARE IN INCHES

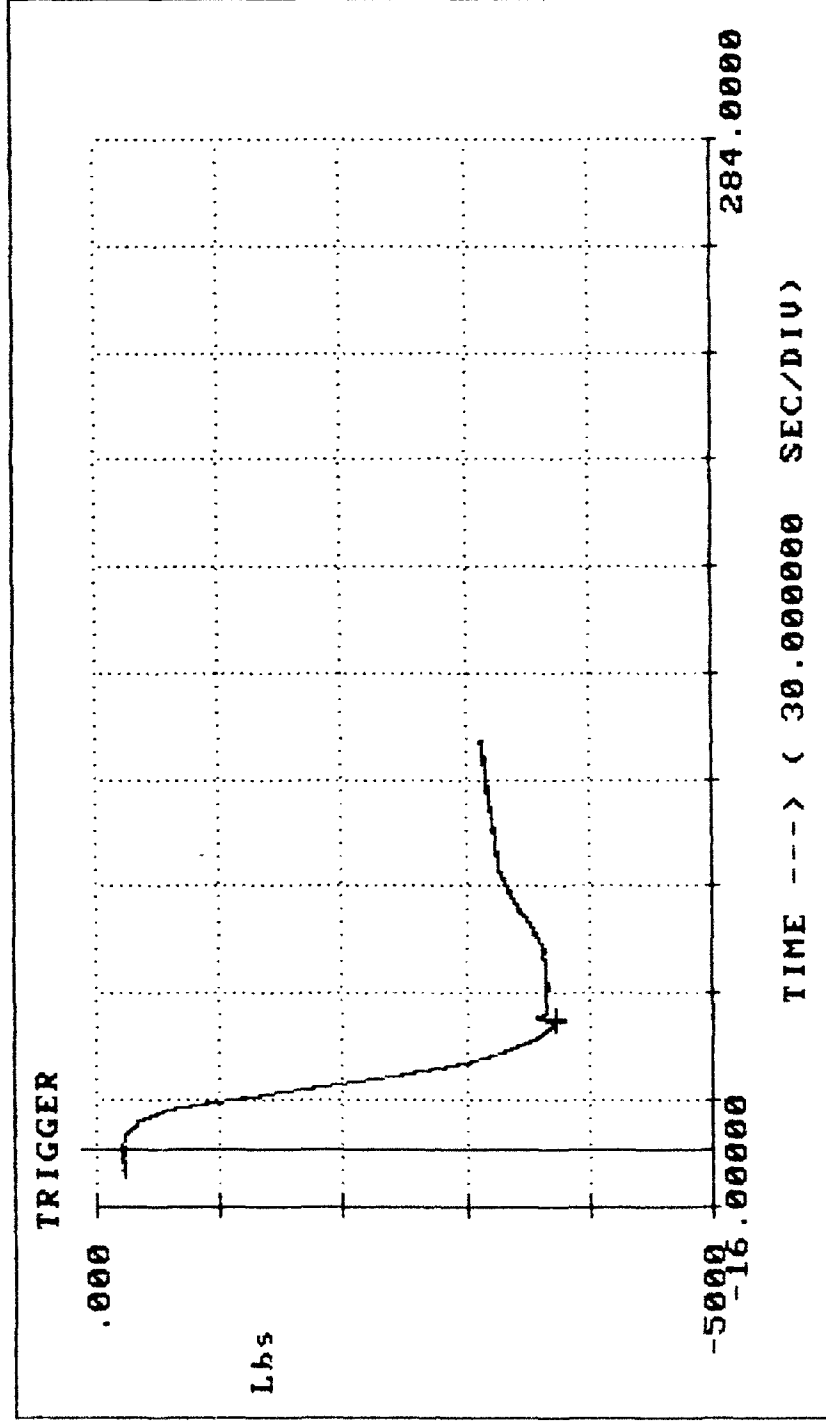
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<p>TITLE</p> <p>TESTING OF LOCALLY FABRICATED TIEDOWN FITTINGS</p>	<p>FIG. #</p> <p>92-023-0-T00076</p>
<p>FITTING #3</p>	<p>VALIDATION ENGINEERING DIVISION</p>
<p>SHEET 1 OF 1</p>	<p></p>

# Tiedown Sample #3

Tested July 23, 1992





LOAD1 TRIGGER OCCURRED 11.231500 SECONDS AFTER START

Hook 3

LEGEND:

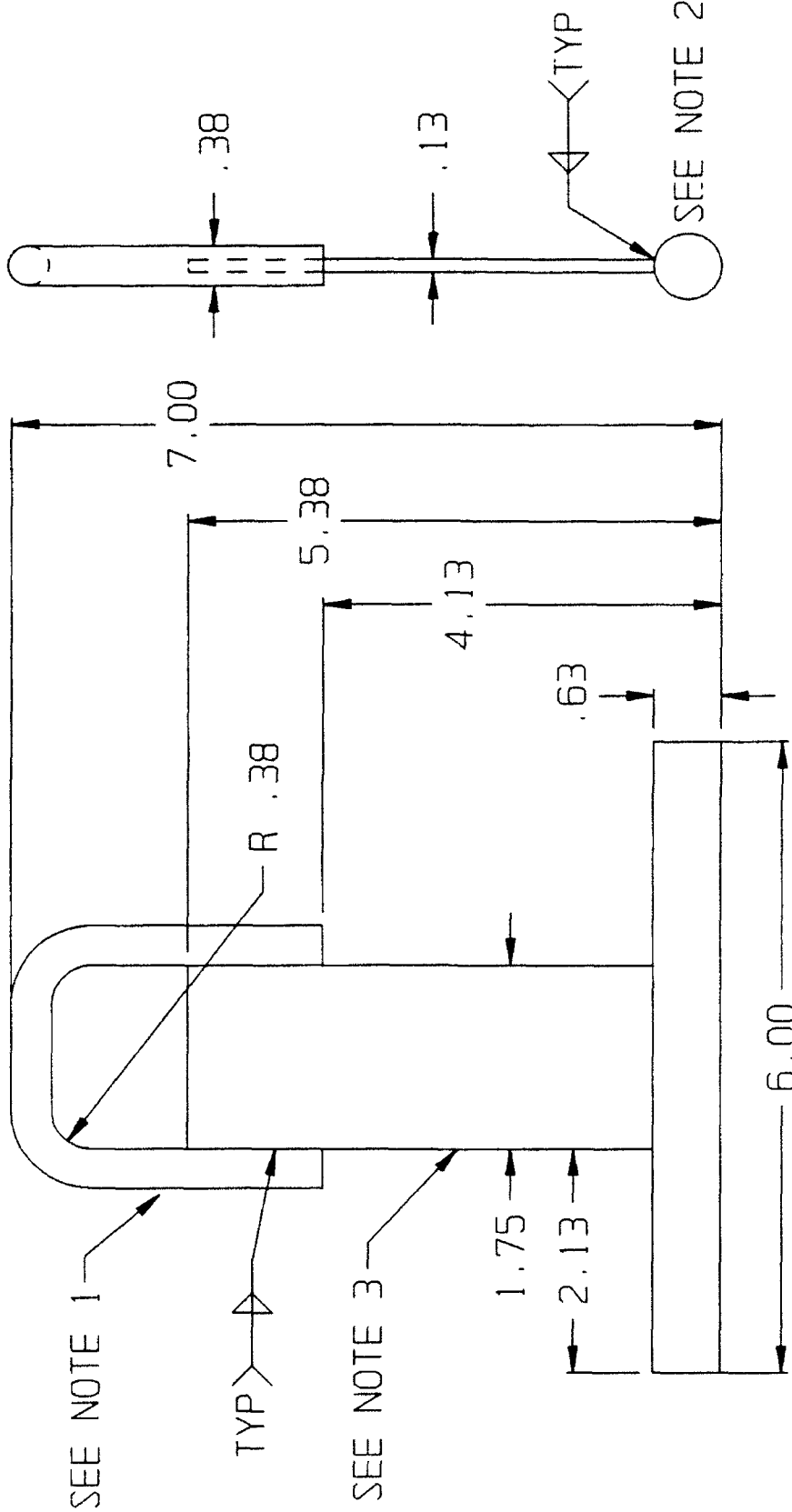
LOAD1

Time= 36.062500 Lbs = -3735.351563

TEST SAMPLE NO. 4:

Explanation of Failure. Test sample no. 4 was also loaded to its weakest orientation with the points of contact at distances of 2 inches from the vertical axis of the tiedown fitting. The test sample was loaded to 7,200 pounds, which broke the bottom bar. It was also noted that the welds holding the bottom bar began to fracture at this point, and that the bar was bent to an angle of 2 degrees from horizontal before failure (see photo).

# LOCALLY FABRICATED TIEDOWN FITTING #4



## NOTE:

1. STEEL, BAR, ROUND, HOT ROLLED, 3/8" DIA X 7-1/2" LONG  
1018, PER ASTM A36 FSC 9520
2. STEEL, BAR, ROUND, HOT ROLLED, 5/8" DIA X 6" LONG  
1018, PER ASTM A36 FSC 9520
3. STEEL, BAR, STRIP, HOT ROLLED, 1/8" X 1-3/4" WIDE X 4-3/4" LONG
4. ALL DIMENSIONS ARE IN INCHES

## FOR INFORMATION ONLY

TESTING OF LOCALLY  
FABRICATED TIEDOWN  
FITTINGS. FITTING #4

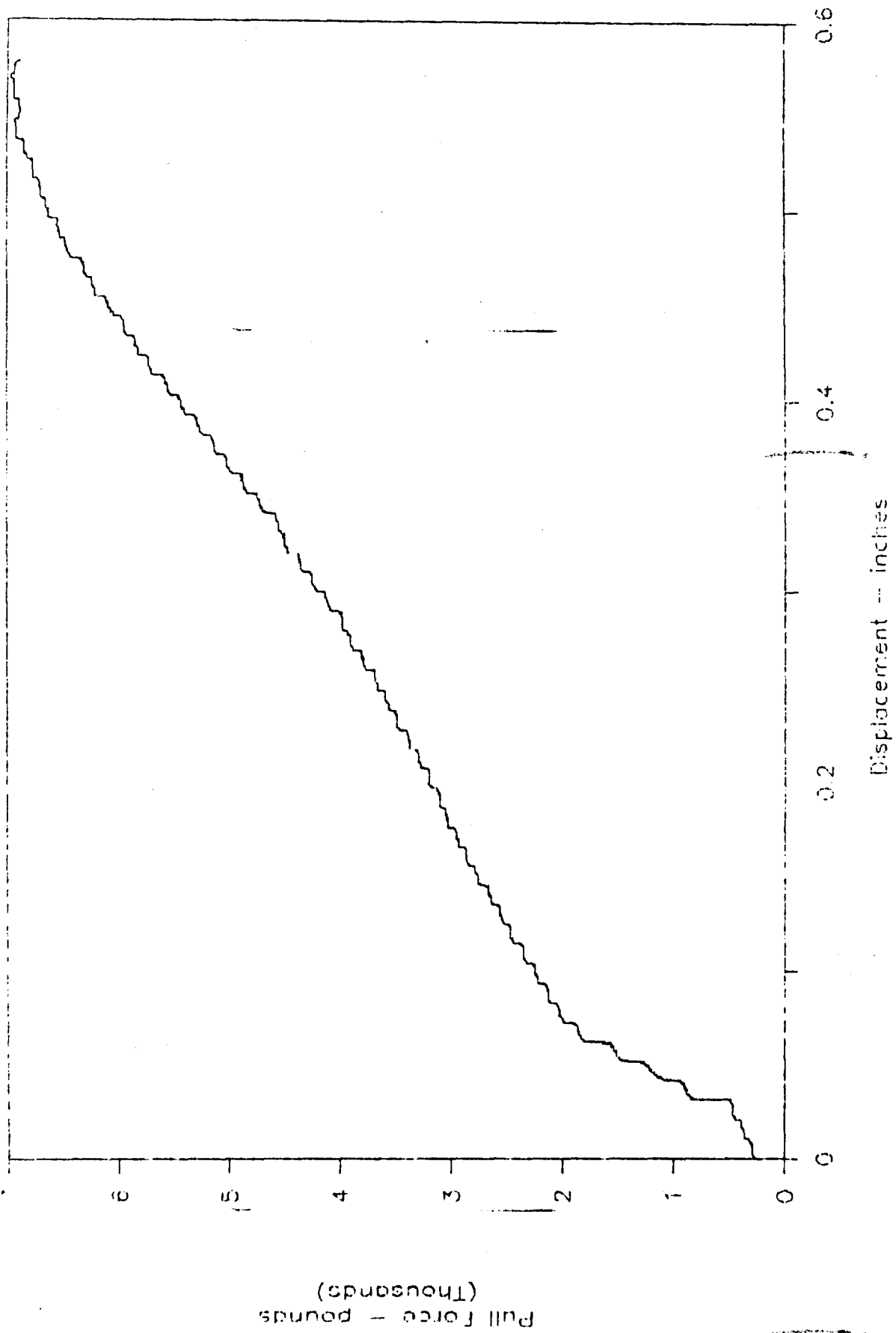
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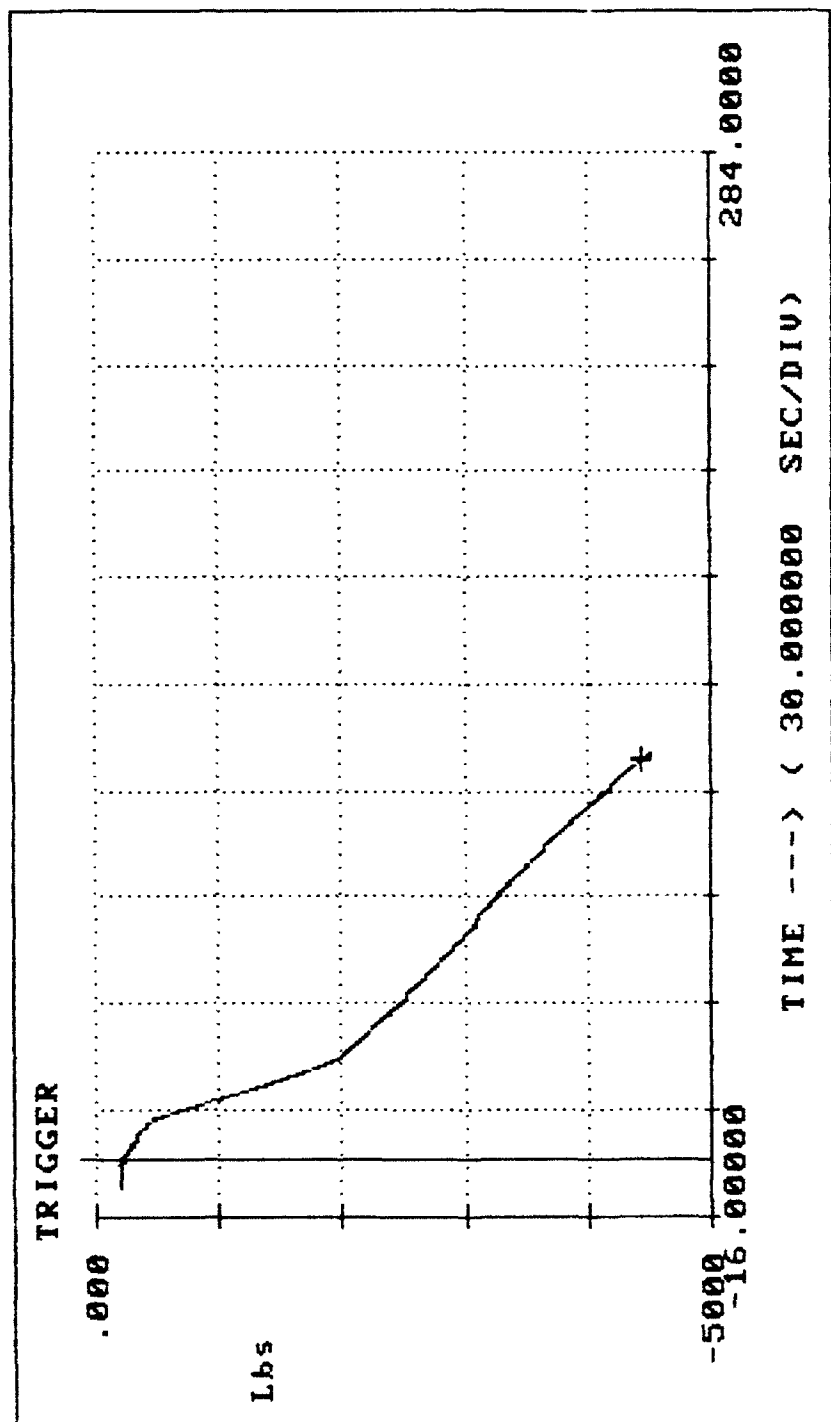
92-023-0-T00077

VALIDATION ENGINEERING DIVISION SHEET 1 OF 1

# Tiedown Sample #4

Tested July 23, 1992





LOAD1 TRIGGER OCCURRED 8.582000 SECONDS AFTER START

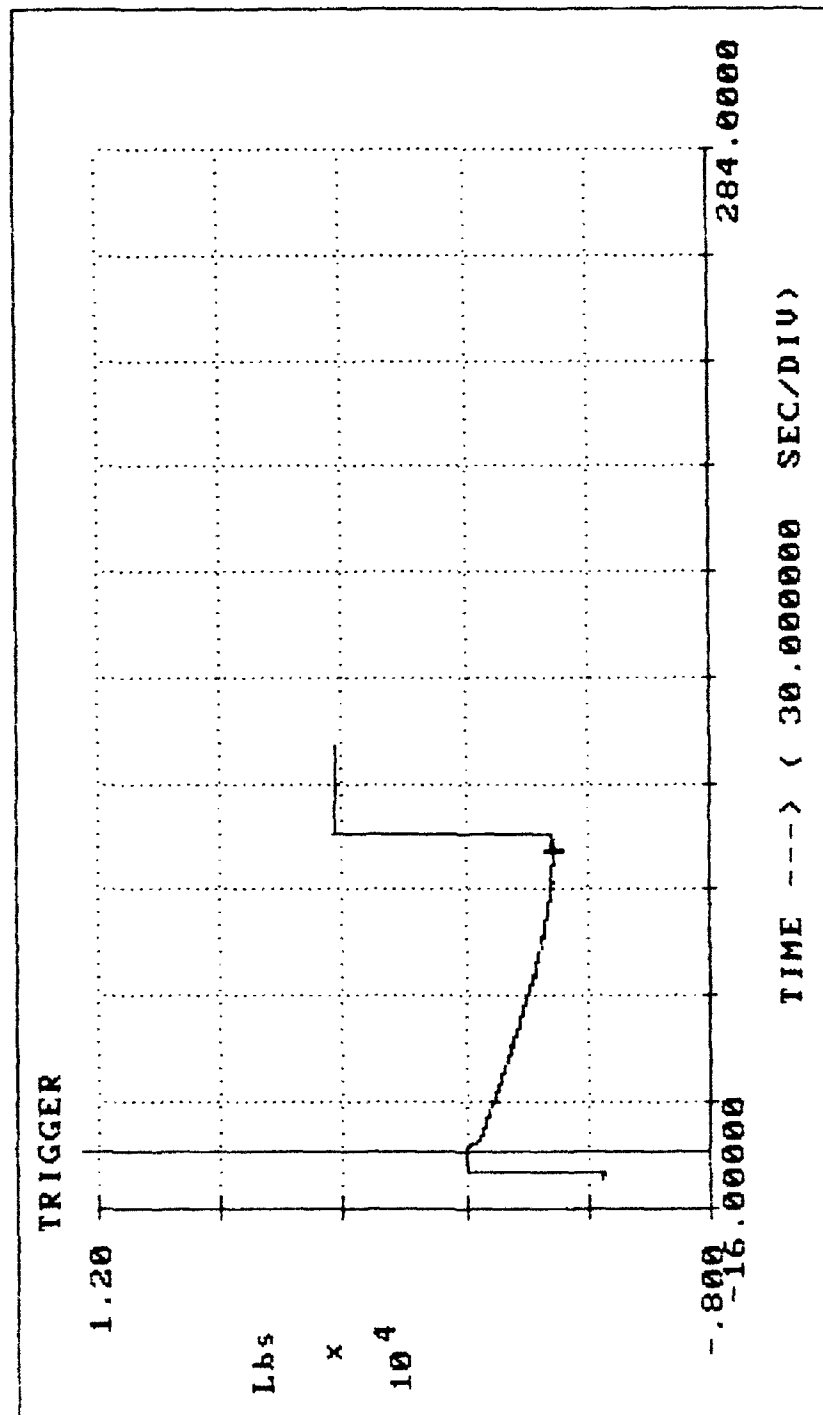
Hook 4 - deformed ring

LEGEND:

LOAD1

Time= 112.754813 Lbs =4443.359375





LOAD1 TRIGGER OCCURRED 6.290500 SECONDS AFTER START

Hook 4a - broke ~7200

LEGEND:

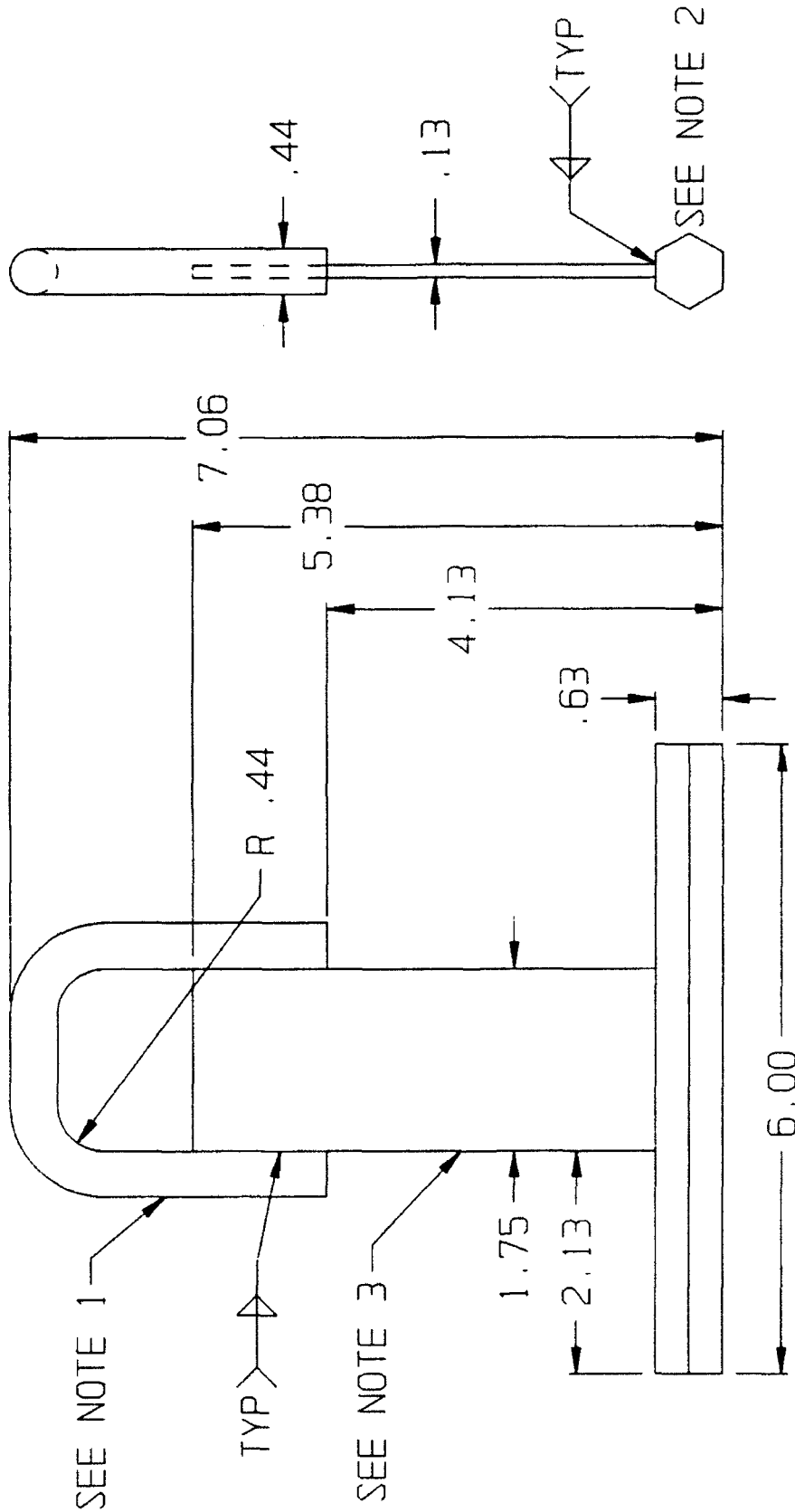
LOAD1

Time= 84.881004 Lbs =-2880.859375

TEST SAMPLE NO. 5:

Explanation of Failure. Test sample no. 5 was loaded in its weakest orientation. The points of contact between the simulated trailer rail and the tiedown bar were located at distances of 2 inches from the vertical axis of the tiedown fitting. This sample yielded at 7,861 pounds when the welds on the hexagonal-shaped bar began to break. It was also noted that the bar was bent 8 degrees from the horizontal position after testing (see photo).

# LOCALLY FABRICATED TIEDOWN FITTING #5



## NOTE:

1. STEEL, BAR, ROUND, HOT ROLLED, 7/16" DIA X 7-1/2" LONG  
1018, PER ASTM A36 FSC 9520
2. STEEL, BAR, HEXAGON, COLD ROLLED, 5/8" DIA X 6" LONG  
1018, PER ASTM A-108
3. STEEL, BAR, STRIP, HOT ROLLED, 1/8" X 1-3/4" WIDE X 3/4" LONG
4. ALL DIMENSIONS ARE IN INCHES

FOR INFORMATION ONLY

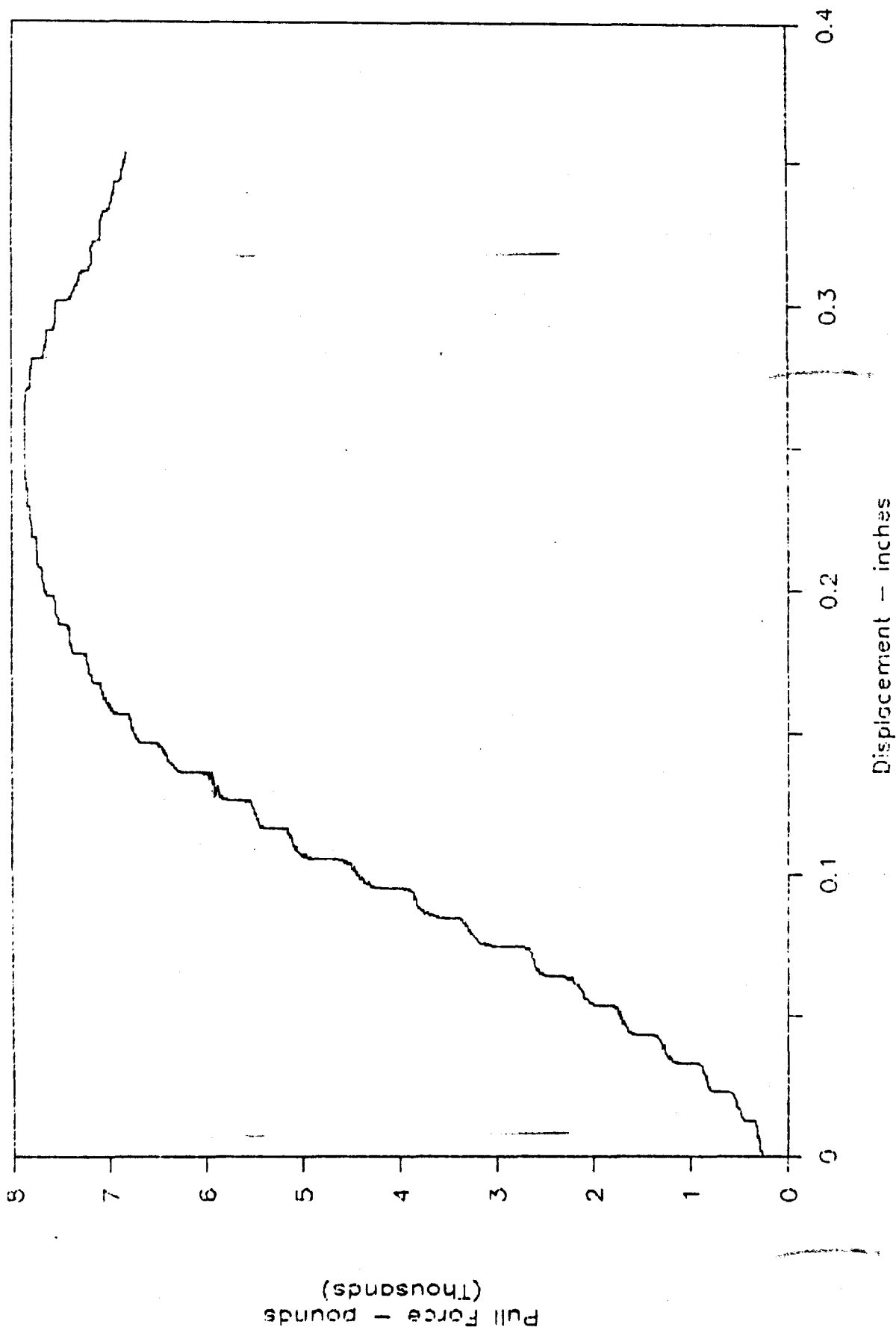
TESTING OF LOCALLY  
FABRICATED TIEDOWN  
FITTINGS, FITTING #5

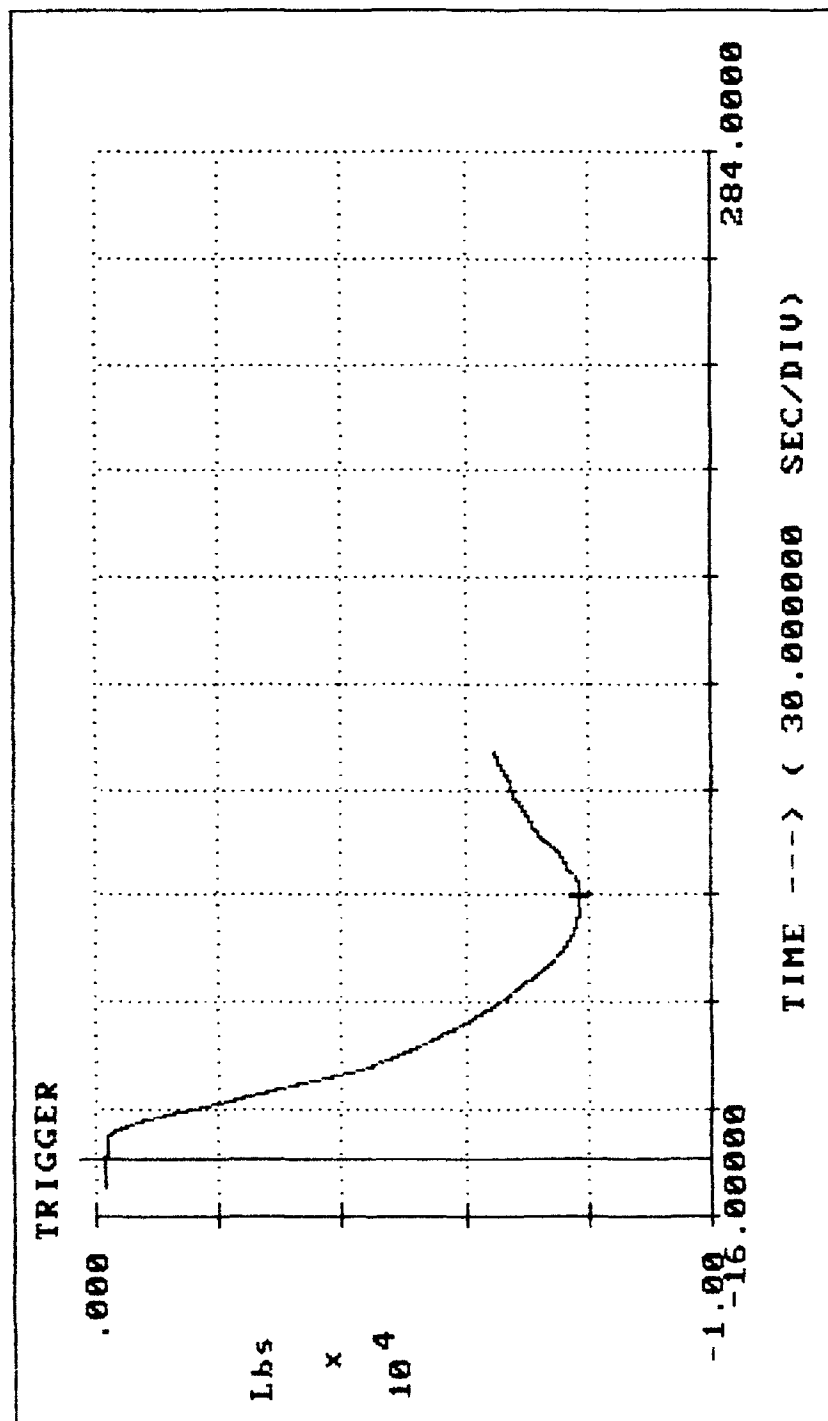
92-023-0-T00078

VALIDATION ENGINEERING DIVISION SHEET 1 OF 1

# Tiedown Sample #5

Tested July 23, 1992





LOAD1 TRIGGER OCCURRED 42.583000 SECONDS AFTER START  
Hook 5

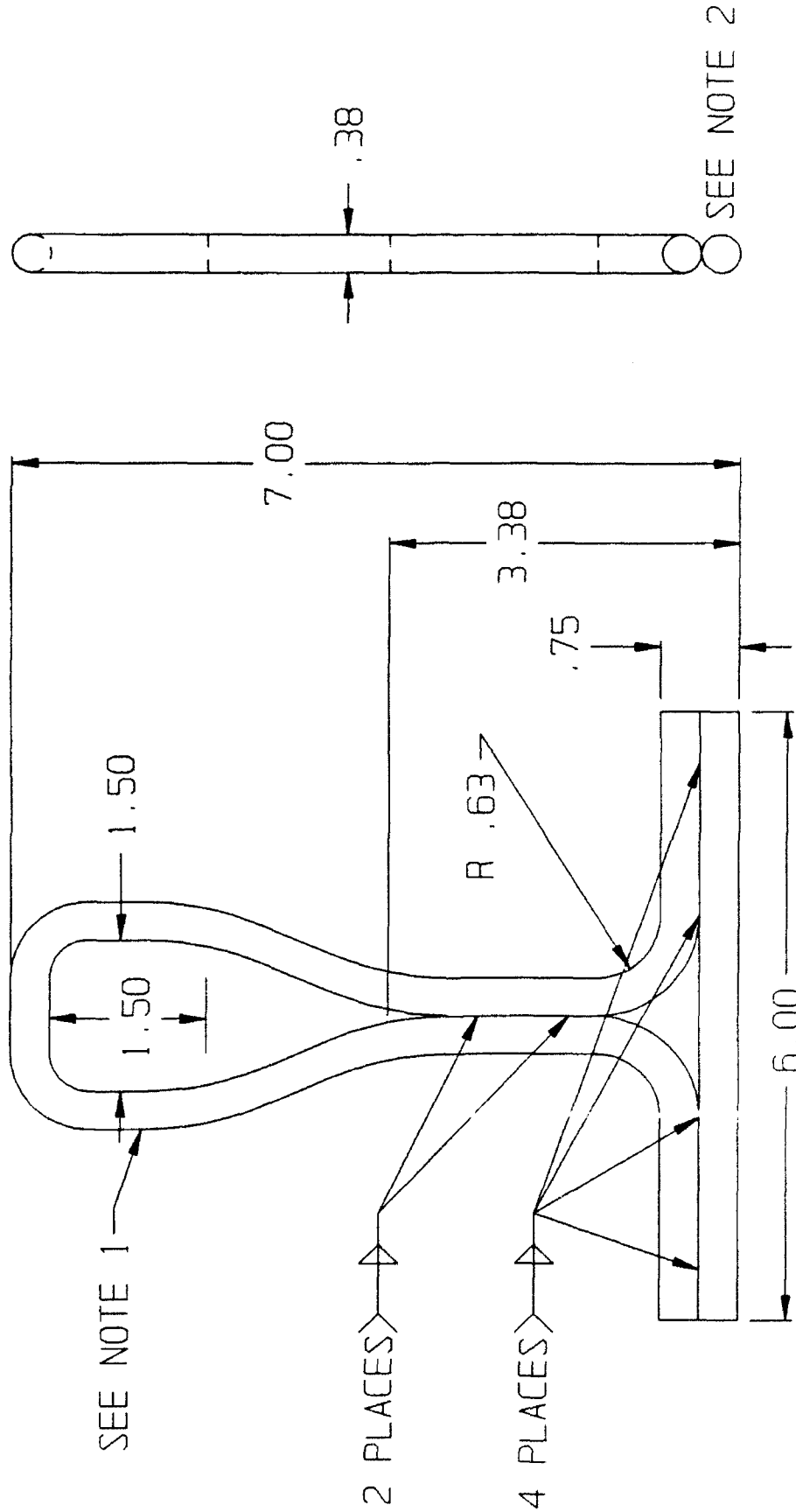
LEGEND:  
LOAD1

Time= 73.797005 lbs =-7861.328125

**TEST SAMPLE NO. 6A:**

**Explanation of Failure.** Test sample no. 6a was loaded in its weakest possible orientation with the points of contact at distances of 2 inches from the vertical axis of the tiedown fitting. This test resulted in some major deformations of the test sample. The entire tiedown fitting was stretched out, including the top loop. This sample yielded at 3,735 pounds when one of the welds in the middle of the fitting failed (see photo). The bottom bar experienced an angle of deformation of 17 degrees from the horizontal position.

# LOCALLY FABRICATED TIEDOWN FITTING #6



## NOTE:

1. STEEL, BAR, ROUND, HOT ROLLED, 3/8" DIA X 20" LONG 1018, PER ASTM A36 FSC 9520
2. STEEL, BAR, ROUND, HOT ROLLED, 3/8" DIA X 6" LONG 1018, PER ASTM A-108
- 3 ALL DIMENSIONS ARE IN INCHES

FOR INFORMATION ONLY

TESTING OF LOCALLY  
FABRICATED TIEDOWN  
FITTINGS, FITTING #6

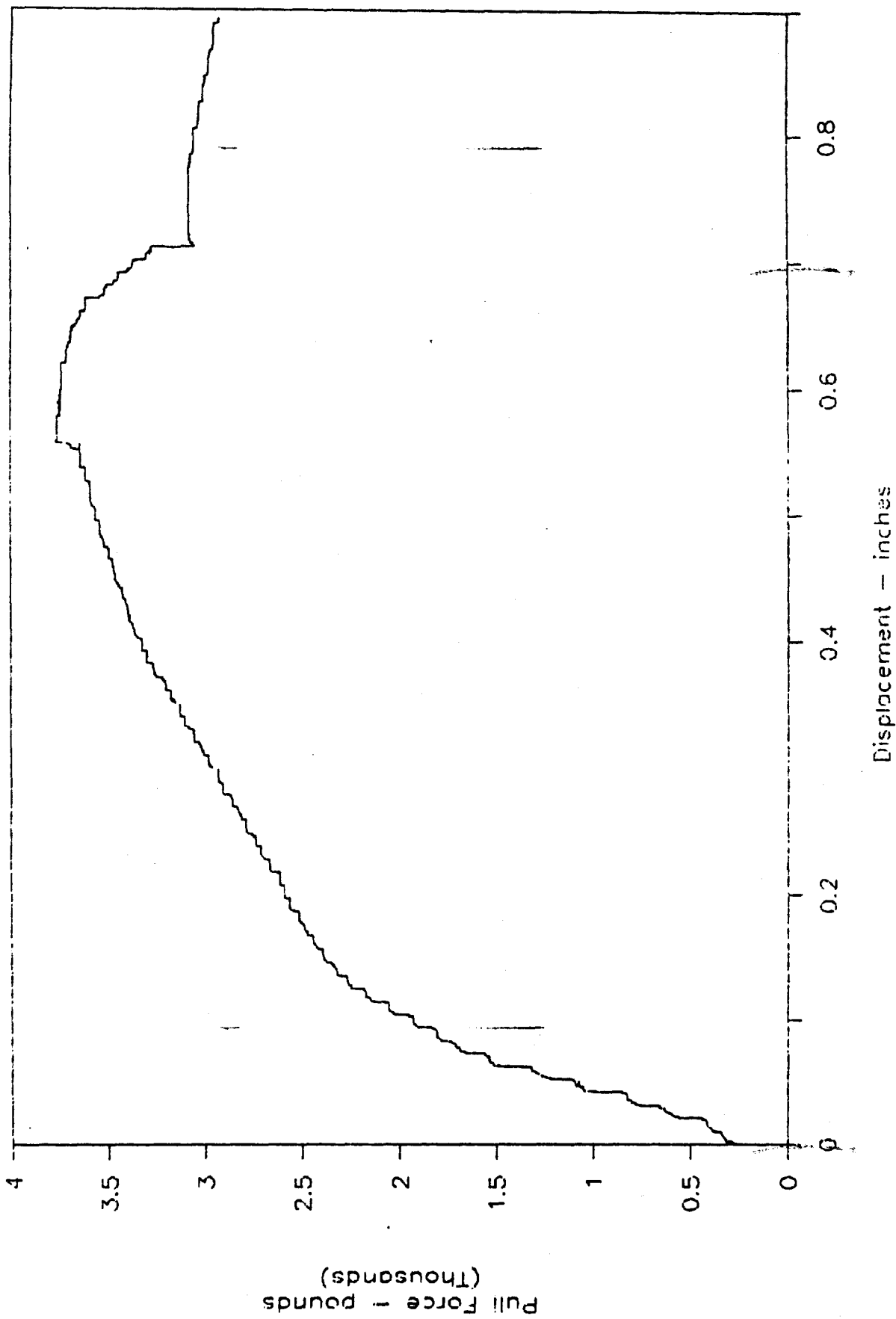
FIG. 6

92-023-0-T00079

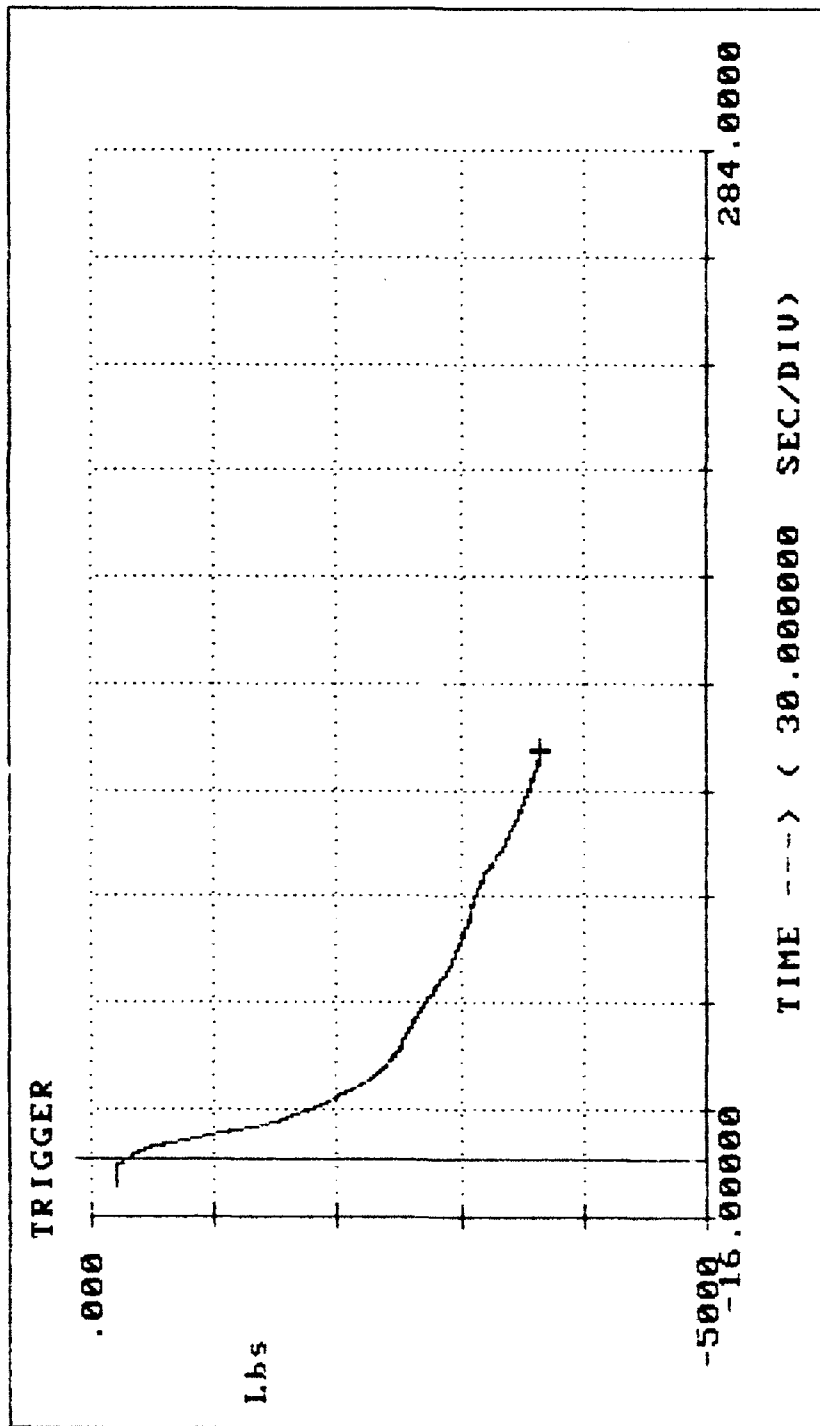
VALIDATION ENGINEERING DIVISION SHEET 1 OF 1

# Tiedown Sample #6a

Tested July 23, 1992







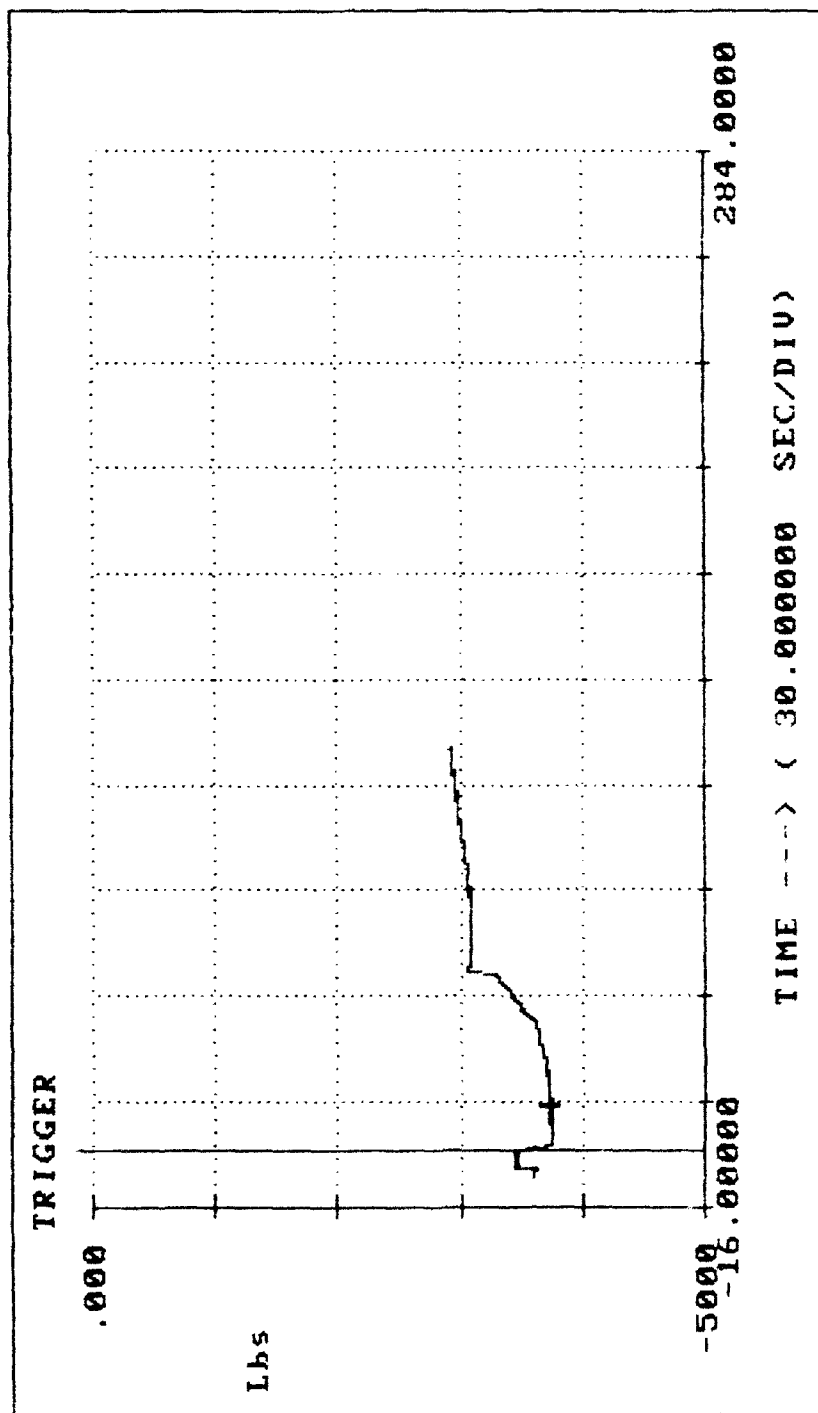
LOAD1 TRIGGER OCCURRED 12.625000 SECONDS AFTER START

Hook 6a

LEGEND:

LOAD1

Time= 114.547012 Lbs =-3662.109375



LOAD1 TRIGGER OCCURRED 5.431500 SECONDS AFTER START

Hook 6a1

LEGEND:

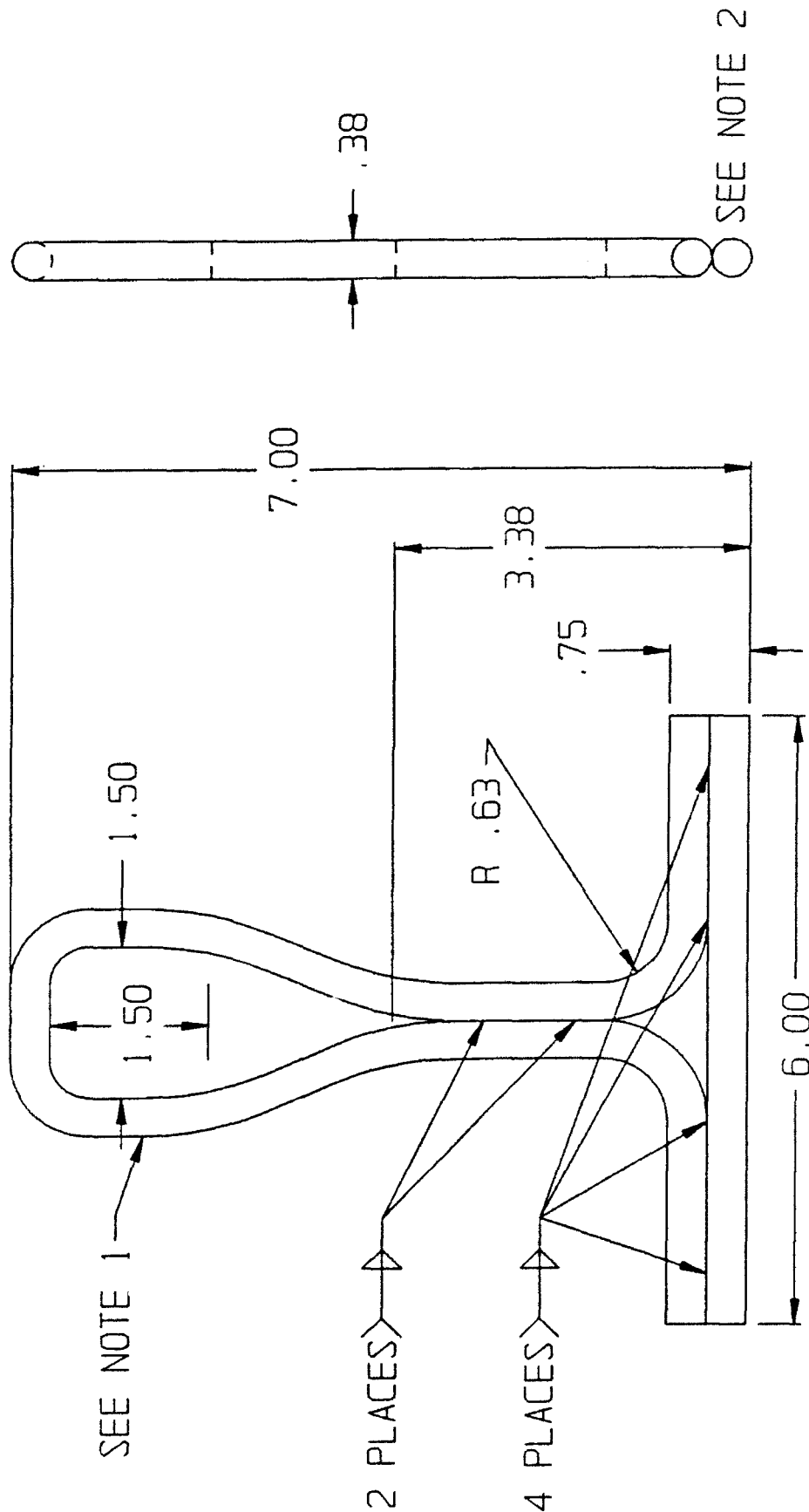
LOAD1

Time= 12.020000 Lbs =-3735.351563

TEST SAMPLE NO. 6B:

Explanation of Failure. Test sample no. 6b and 6a are of the same design configuration, however, test sample no. 6b was tested in a much stronger orientation than test sample no. 6a. The points of contact were located at distances of 1-inch from the tiedown fitting's vertical axis. The deformation of this fitting began with the top loop bending into an oval shape and continued with the bottom bars bending to an angle of 10 degrees from the horizontal position. When the load reached 7,592 pounds, the bottom bar failed and broke (see photo).

# LOCALLY FABRICATED TIEDOWN FITTING #6



## NOTE:

1. STEEL, BAR, ROUND, HOT ROLLED, 3/8" DIA X 20" LONG 1018, PER ASTM A36 FSC 9520
2. STEEL, BAR, ROUND, HOT ROLLED, 3/8" DIA X 6" LONG 1018, PER ASTM A-108
3. ALL DIMENSIONS ARE IN INCHES

FOR INFORMATION ONLY

TESTING OF LOCALLY  
FABRICATED TIEDOWN  
FITTINGS. FITTING #6

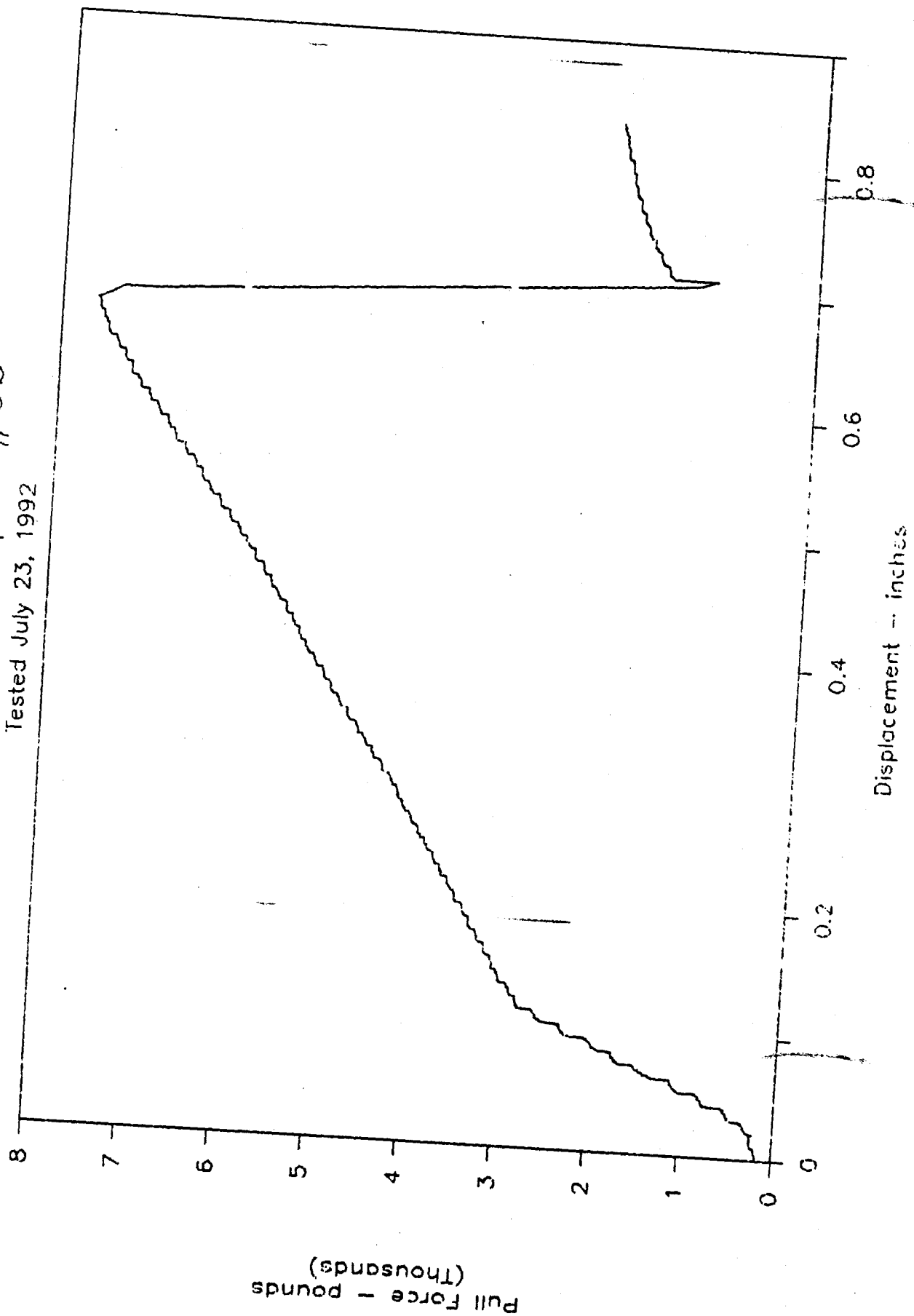
DATE

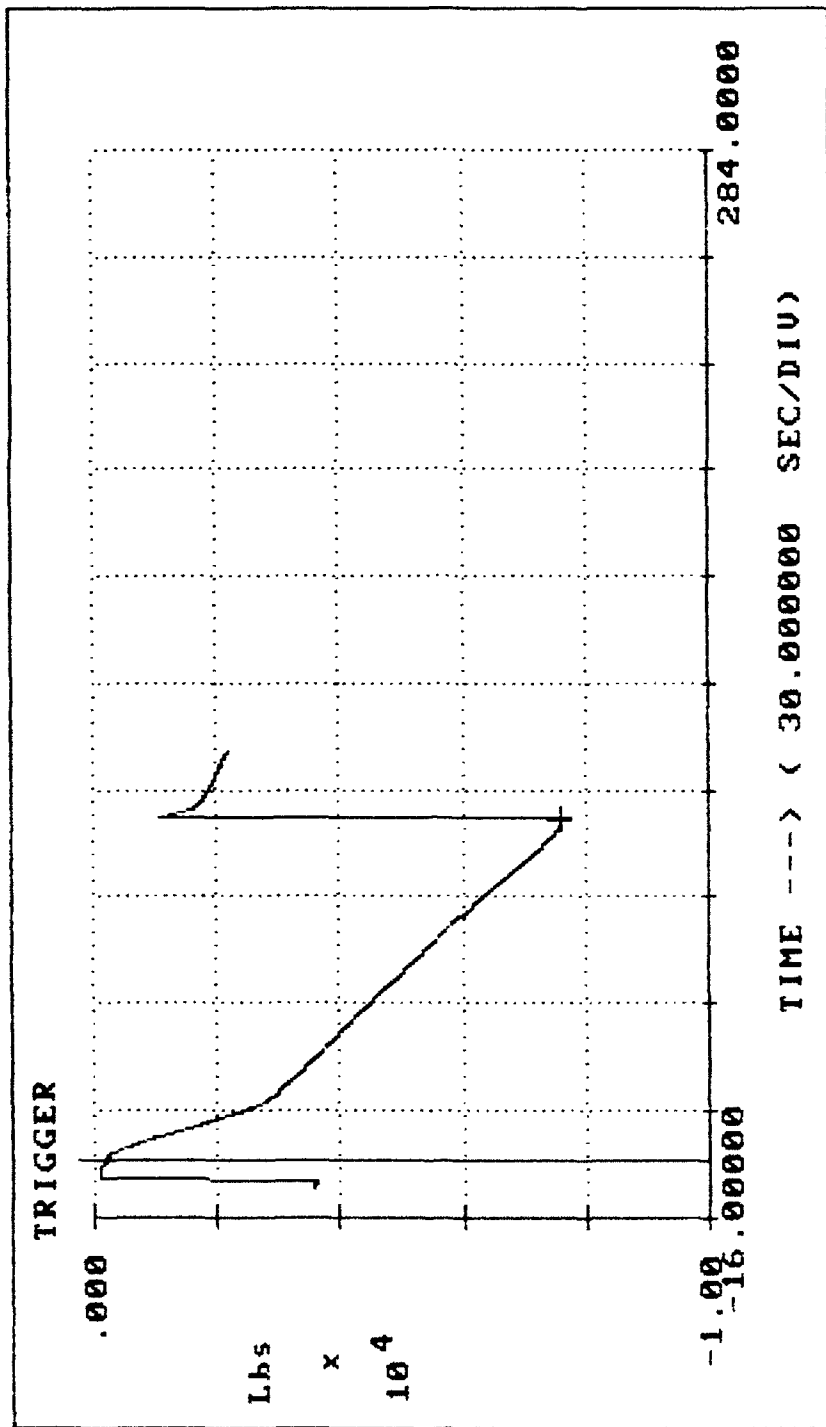
92-023-0-T00079

VALIDATION ENGINEERING DIVISION SHEET 1 OF 1

# Tiedown Sample #6b

Tested July 23, 1992





LOAD1 TRIGGER OCCURRED 5.677500 SECONDS AFTER START

Hook 6b

LEGEND:

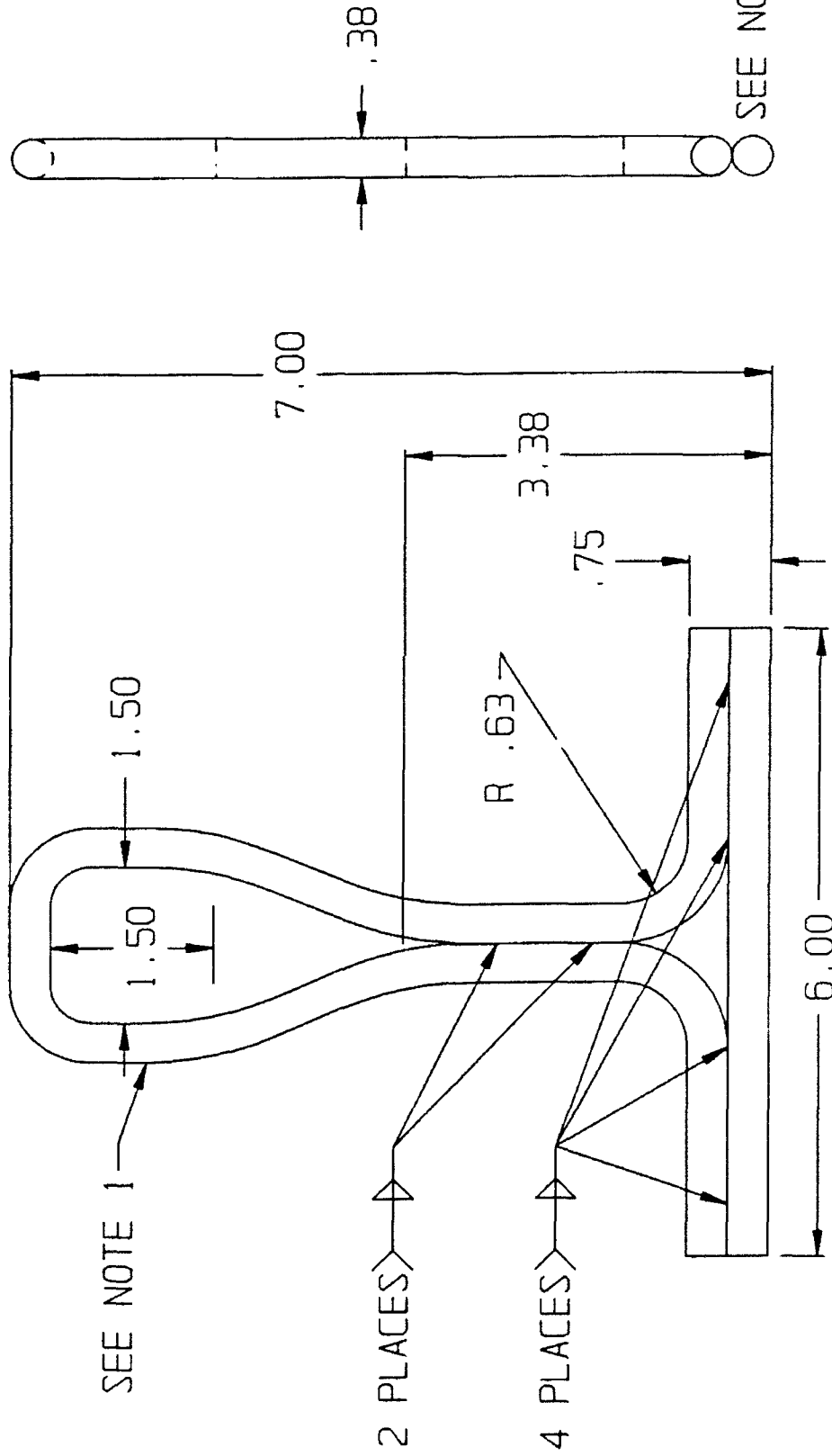
LOAD1

Time= 95.313011 Lbs =-7592.773437

TEST SAMPLE NO. 6C:

Explanation of Failure. Test samples nos. 6a, 6b, and 6c are of the same design configuration. Test sample no. 6c was oriented in its weakest position, similar to test sample no. 6a, with the points of contact at distances of 2 inches from its vertical axis. This test sample sustained slight deformation to the top loop, and the bottom bar was bent to an angle of 10 degrees from the horizontal position. When this sample reached a load of 3,100 pounds, one of the welds in the middle of the fitting failed (see photo).

# LOCALLY FABRICATED TIEDOWN FITTING #6



SEE NOTE 2

FOR INFORMATION ONLY

NOTE:

1. STEEL, BAR, ROUND, HOT ROLLED, 3/8" DIA X 20" LONG  
1018, PER ASTM A36 FSC 9520
2. STEEL, BAR, ROUND, HOT ROLLED, 3/8" DIA X 6" LONG  
1018, PER ASTM A-108
3. ALL DIMENSIONS ARE IN INCHES

TITLE  
TESTING OF LOCALLY  
FABRICATED TIEDOWN  
FITTINGS. FITTING #6

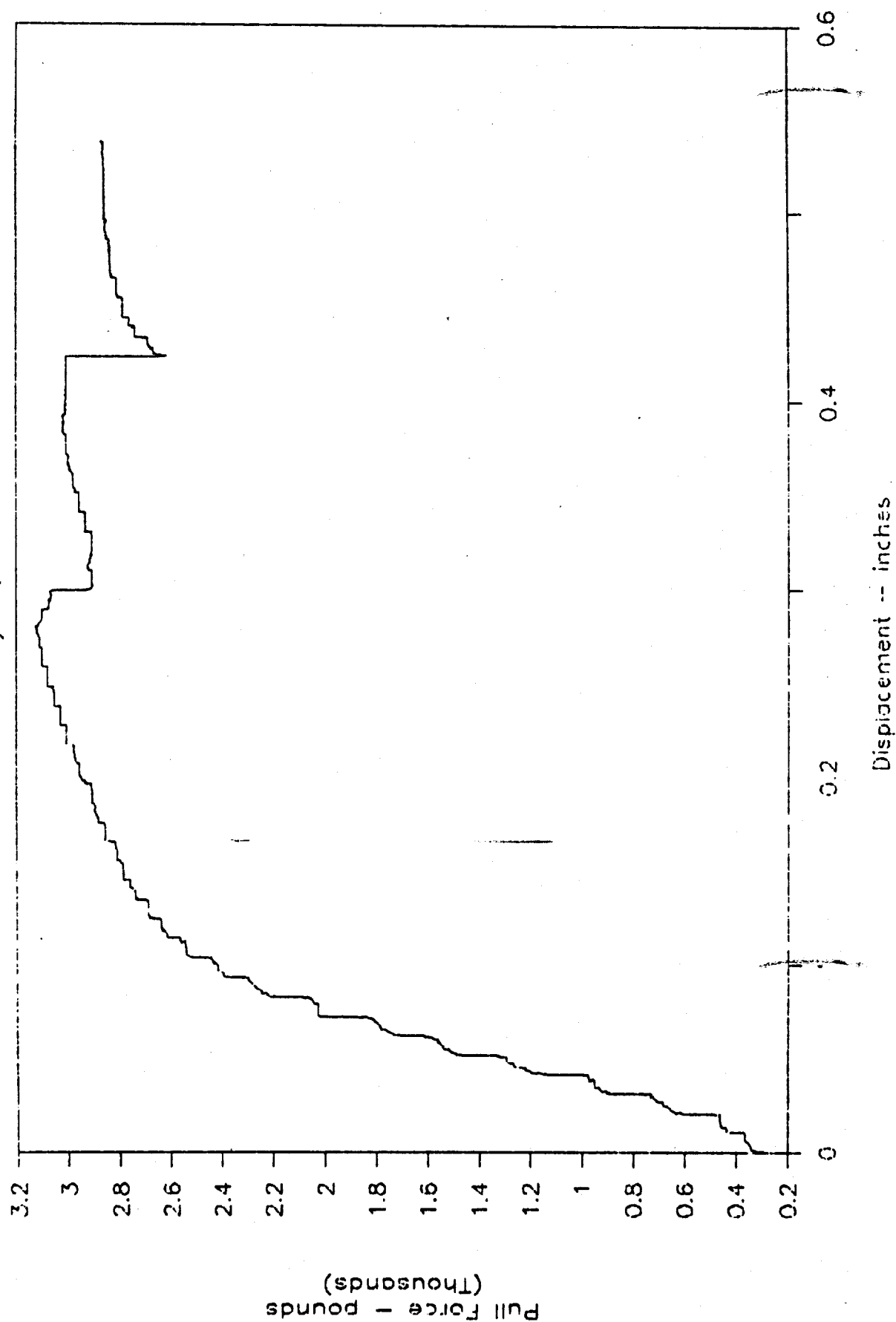
92-023-0-T00079

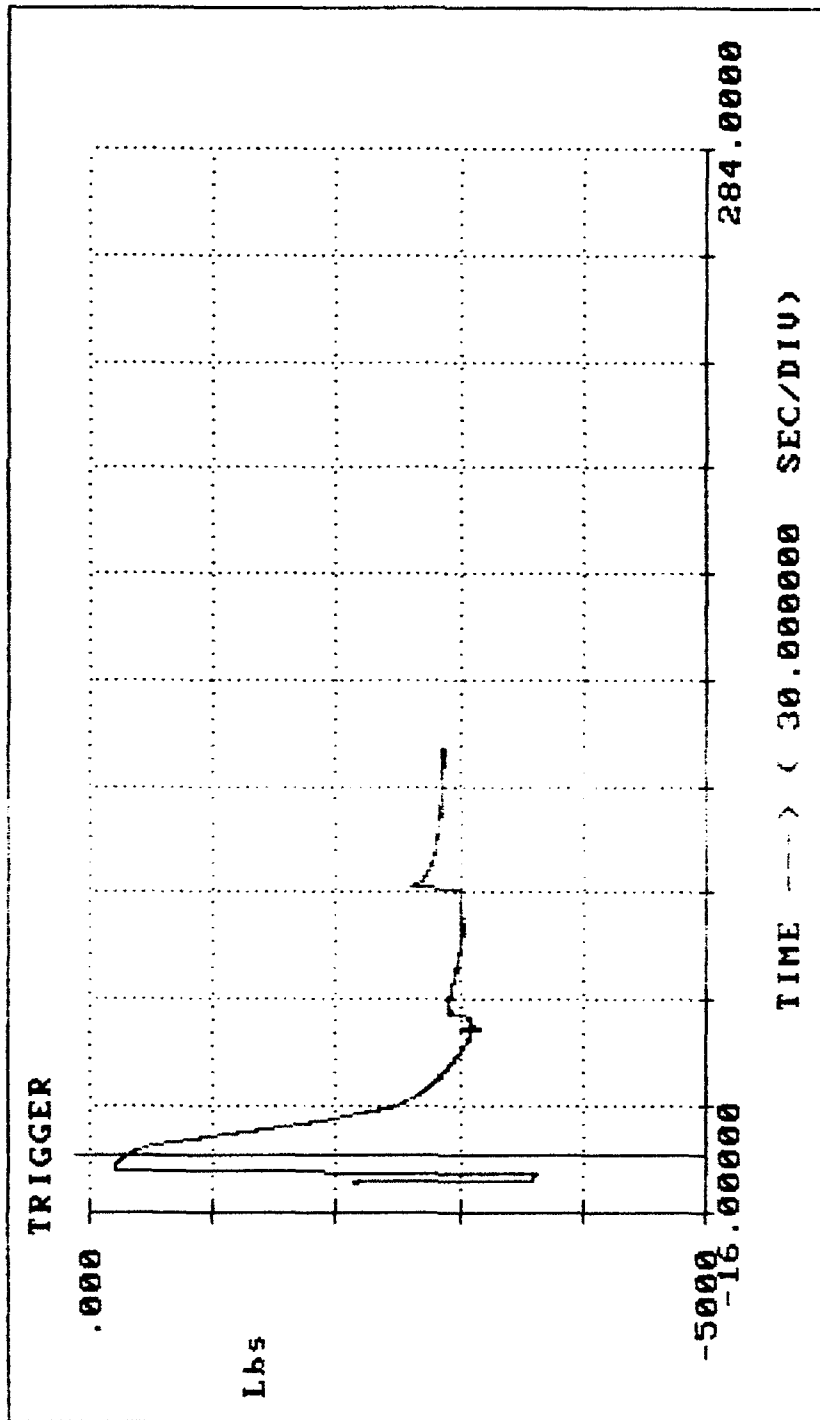
VALIDATION ENGINEERING DIVISION SHEET 1 OF 1



# Tiedown Sample #6c

Tested July 23, 1992





LOAD1 TRIGGER OCCURRED 4.990500 SECONDS AFTER START

Hook 6c

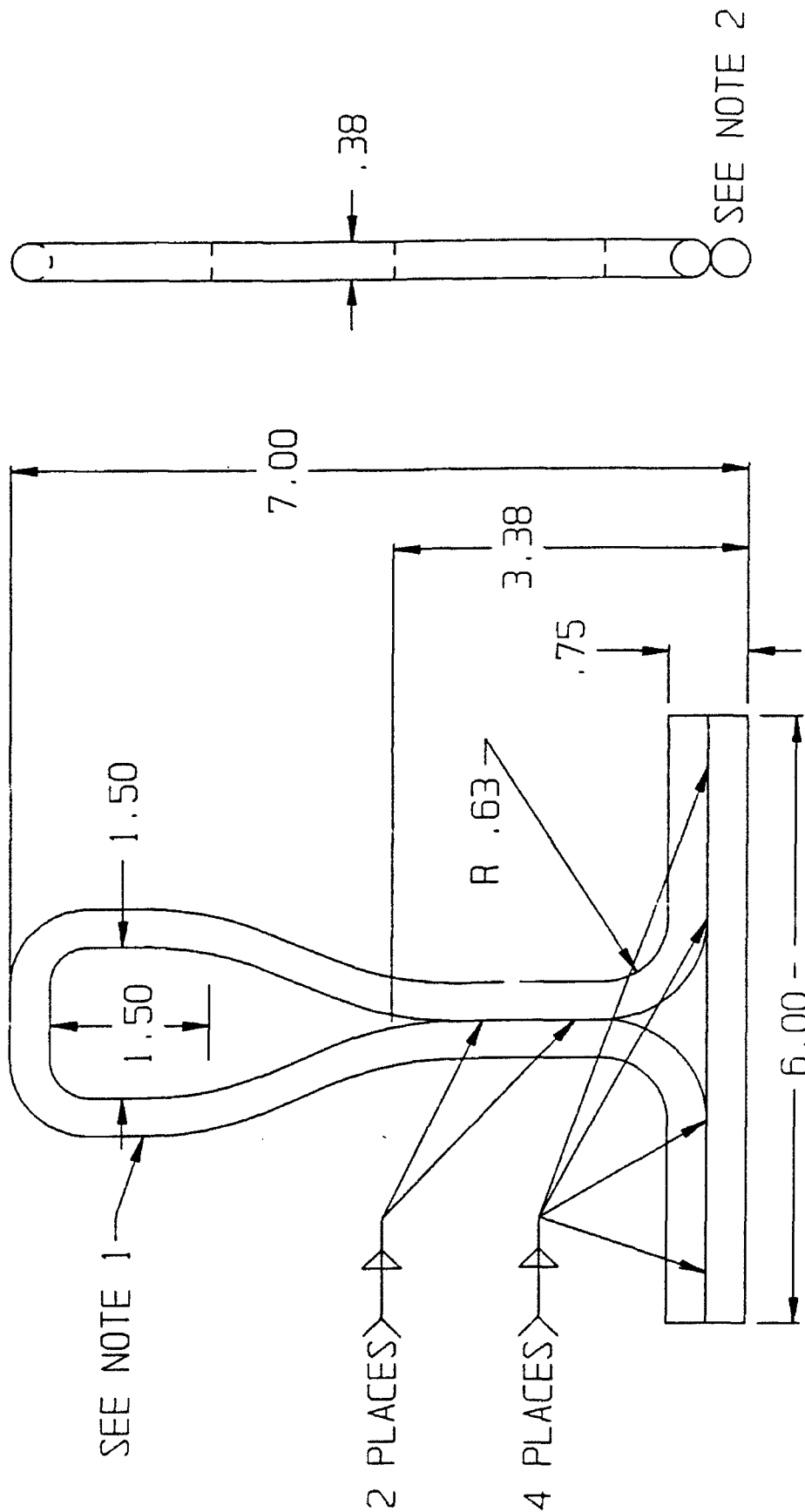
LEGEND:  
LOAD1

Time= 35.492001 Lbs = 3100.585938

TEST SAMPLE NO. 6D:

Explanation of Failure. Test samples nos. 6a, 6b, 6c, and 6d are of the same design configuration; however, test sample no. 6d was loaded so that one point of contact was located 1-inch from the vertical axis, while the other point of contact was at a distance of 3/4-inch. This test sample also experienced alot of overall stretching including the top hook. When the test load reached 7,080 pounds, one of the welds in the middle section of the fitting failed, and it was also noted that the rod used in forming the tiedown fitting had passed its yielding point and was stretching apart (see photo).

LOCALLY FABRICATED TIEDOWN FITTING #6



SEE NOTE 2

**NOTE:**

1. STEEL, BAR, ROUND, HOT ROLLED, 3/8" DIA X 20" LONG  
1018, PER ASTM A36 FSC 9520
2. STEEL, BAR, ROUND, HOT ROLLED, 3/8" DIA X 6" LONG  
1018, PER ASTM A-108
3. ALL DIMENSIONS ARE IN INCHES

FOR INFORMATION ONLY

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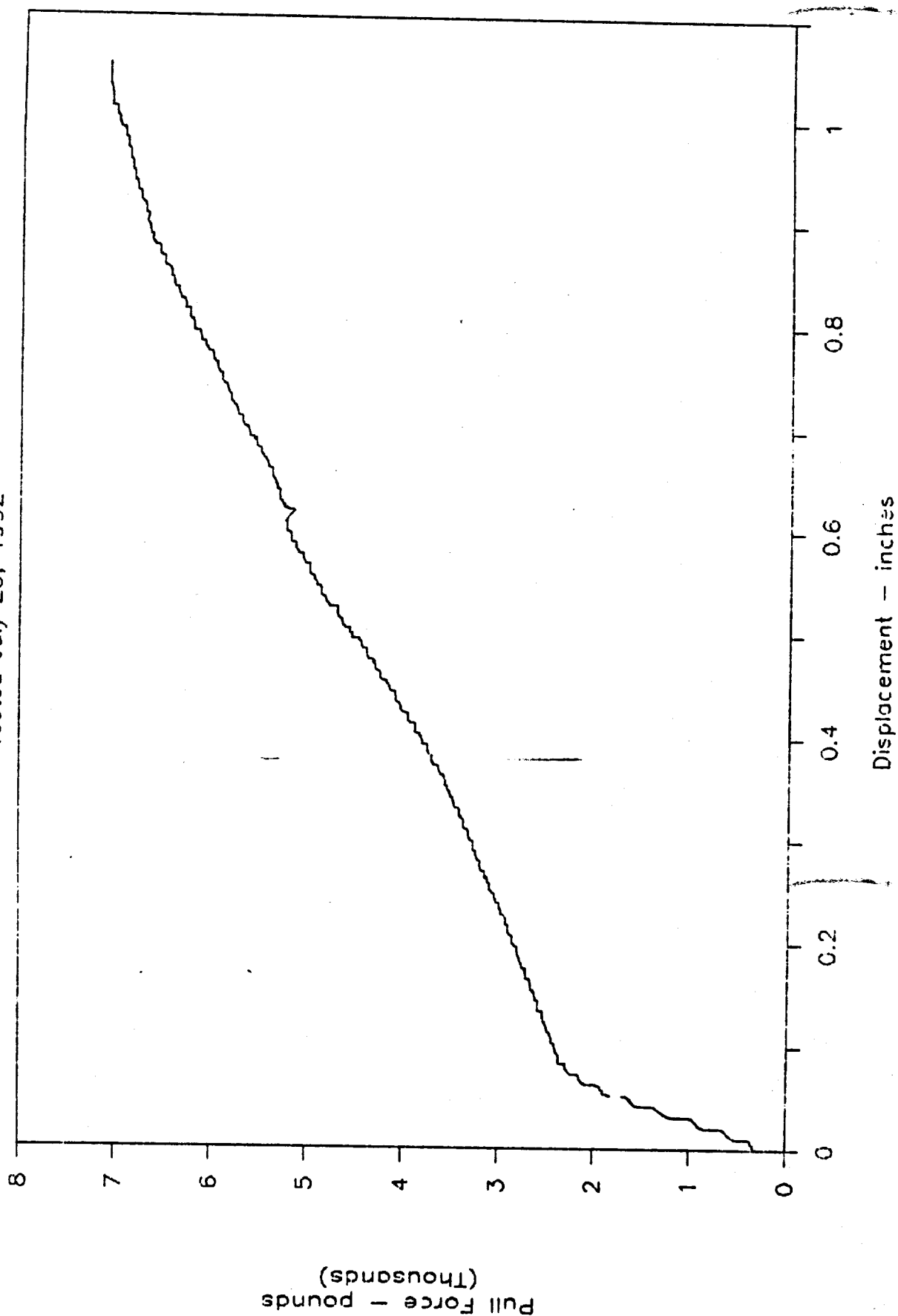
**Over 100**

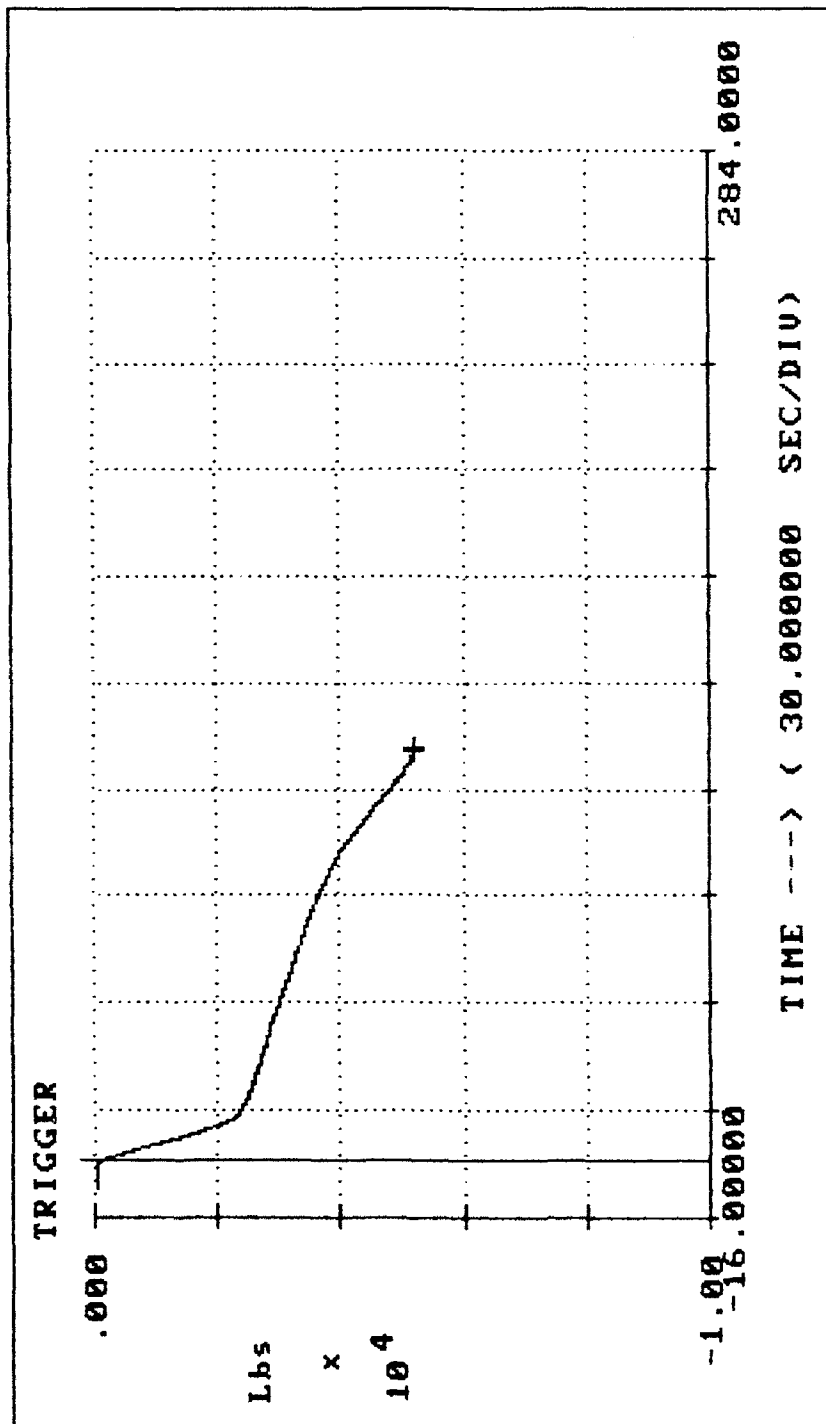
92-023-0-T00079

VALIDATION ENGINEERING DIVISION SHEET 1 OF 1

# Tiedown Sample #6d

Tested July 23, 1992

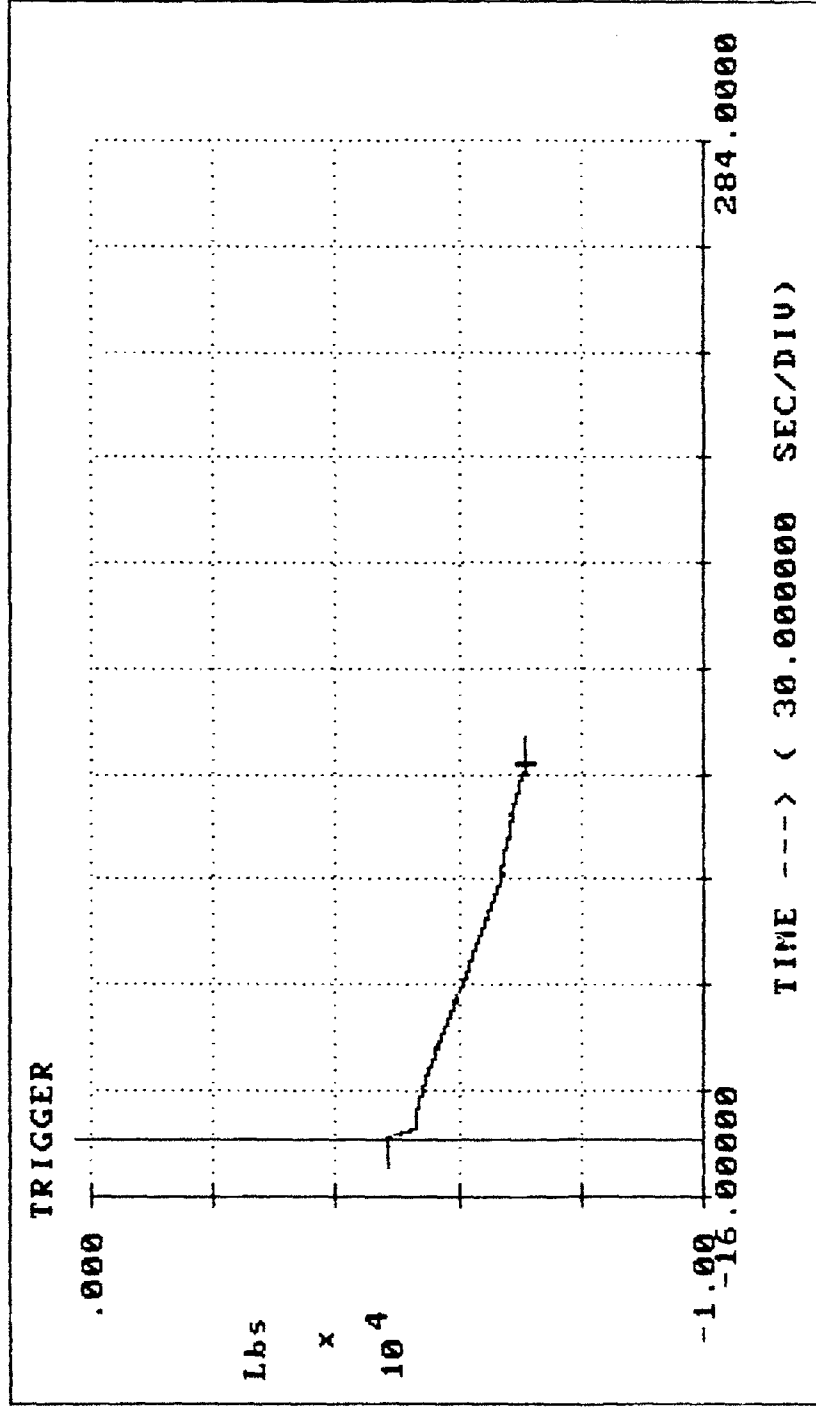




LOAD1 TRIGGER OCCURRED 14.113000 SECONDS AFTER START  
Hook 6d

LEGEND:  
LOAD1

Time= 114.710007 Lbs =-5224.609375



LOAD1 TRIGGER OCCURRED 34.814000 SECONDS AFTER START

Hook 6d1

LEGEND:  
LOAD1

Time= 106.397011 Lbs =-7000.078125

PART 7

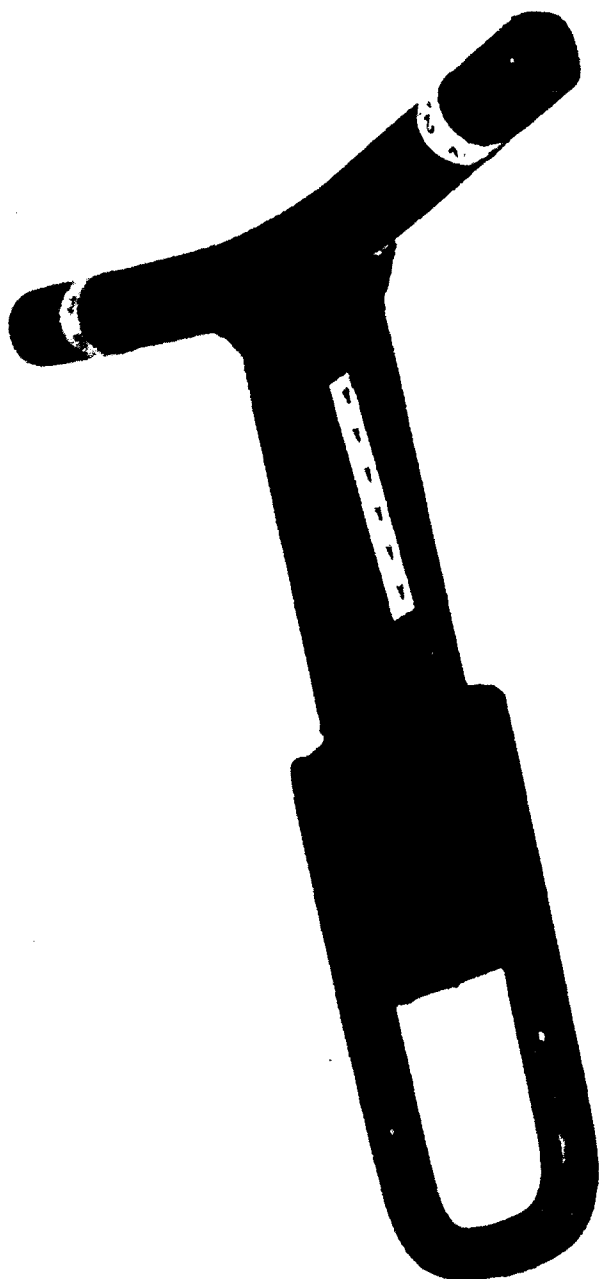
PHOTOGRAPHS



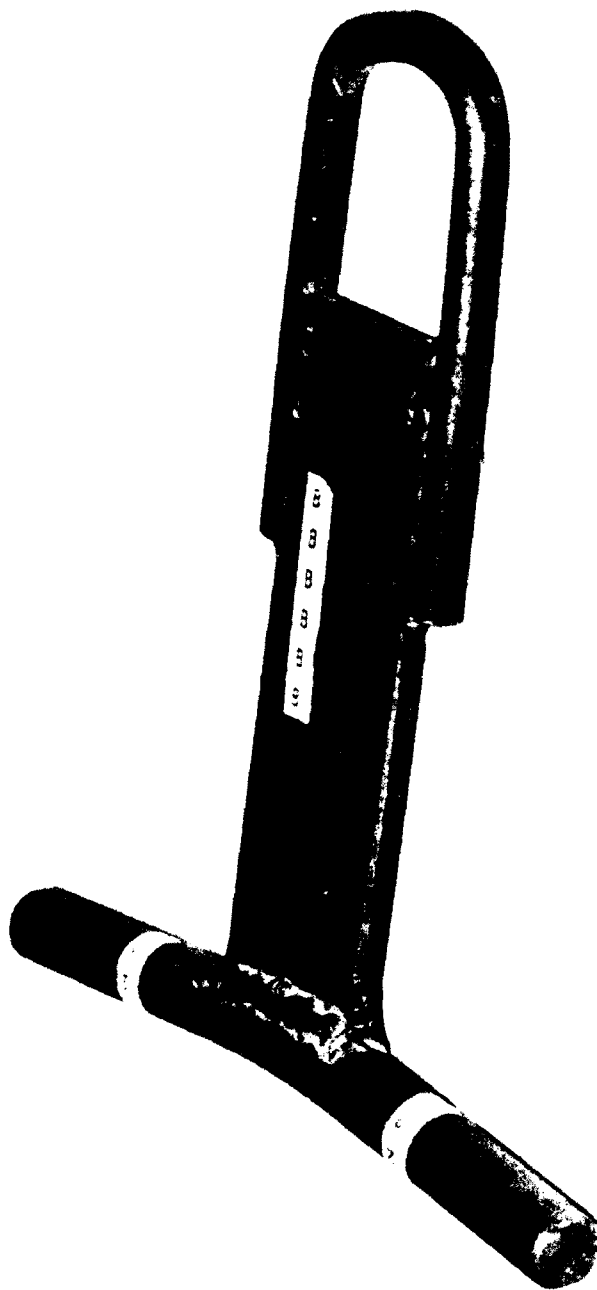


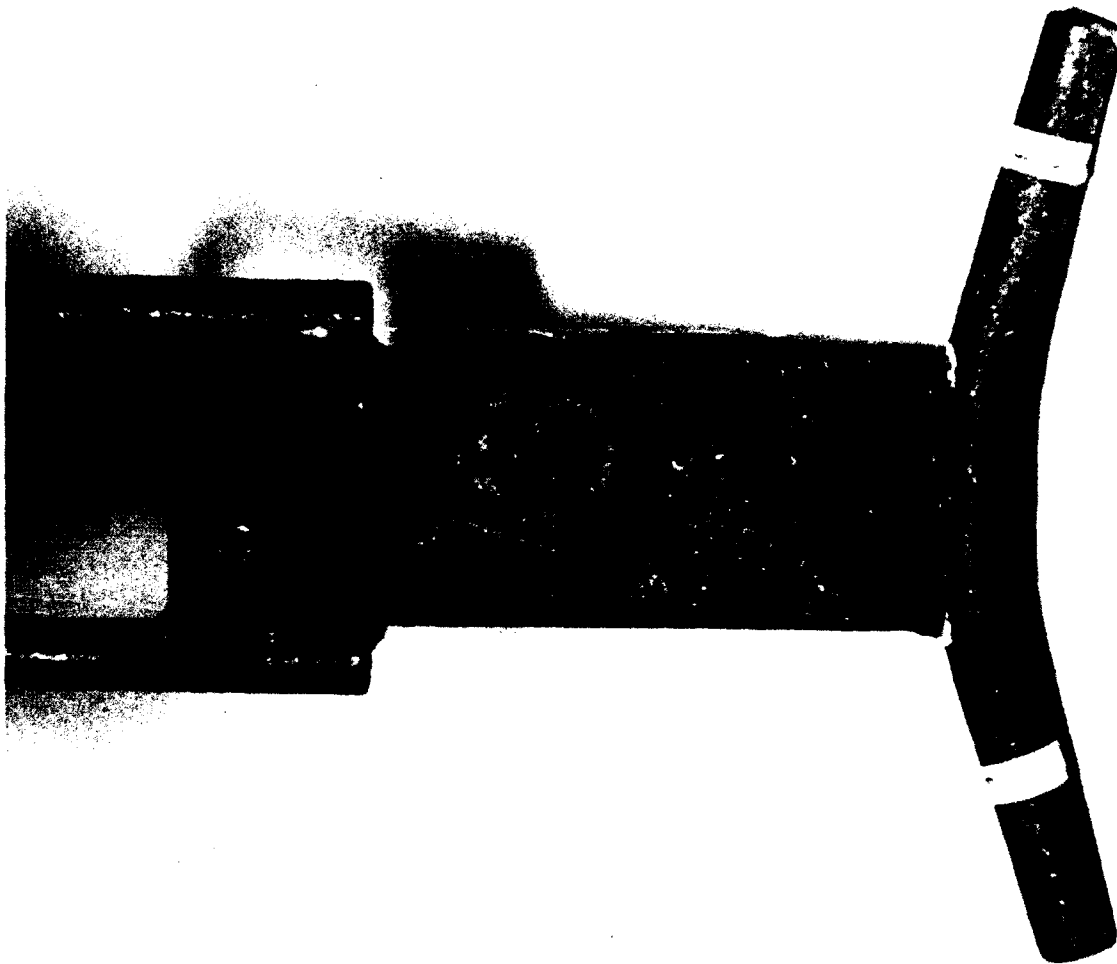
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. AO317-SCN92-350-4732. Test sample No. 1. This tie-down fitting withstood the greatest tensile load of all field-fabricated tie-down fittings. Testing failed due to the design and interface with the trailer side rail. The sharp corner of the angle steel stock cut into the underside of the trailer rail, damaging the rail.

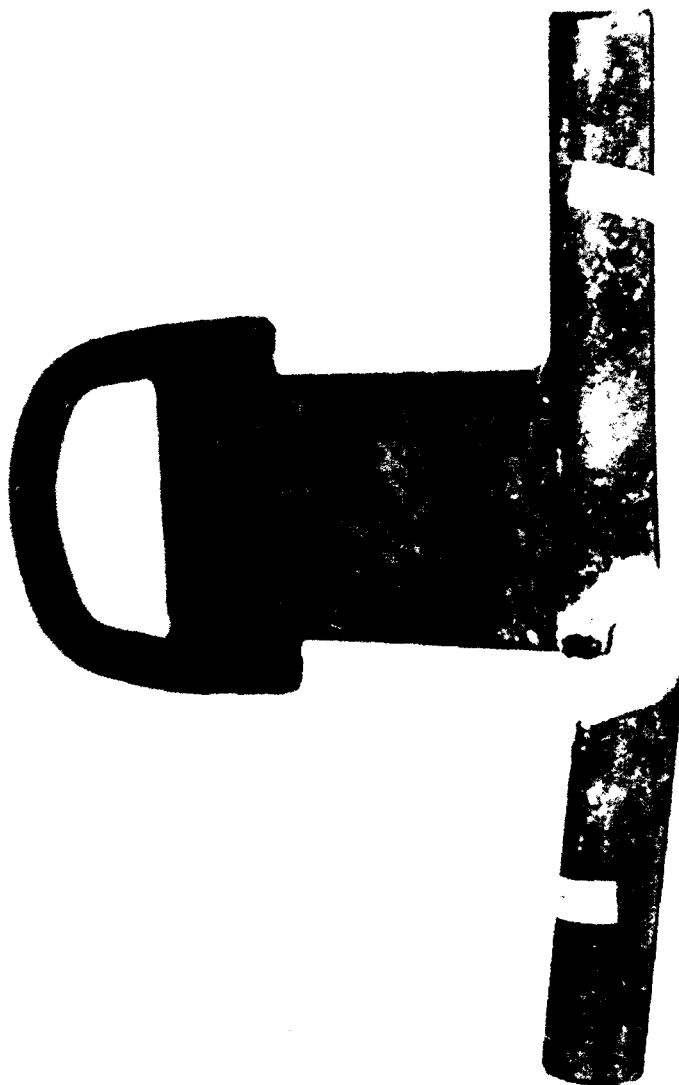


	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
Photo No. AO317-SCN92-350-4733. Test sample No. 2a. This test sample failed at 2,700 pounds.		

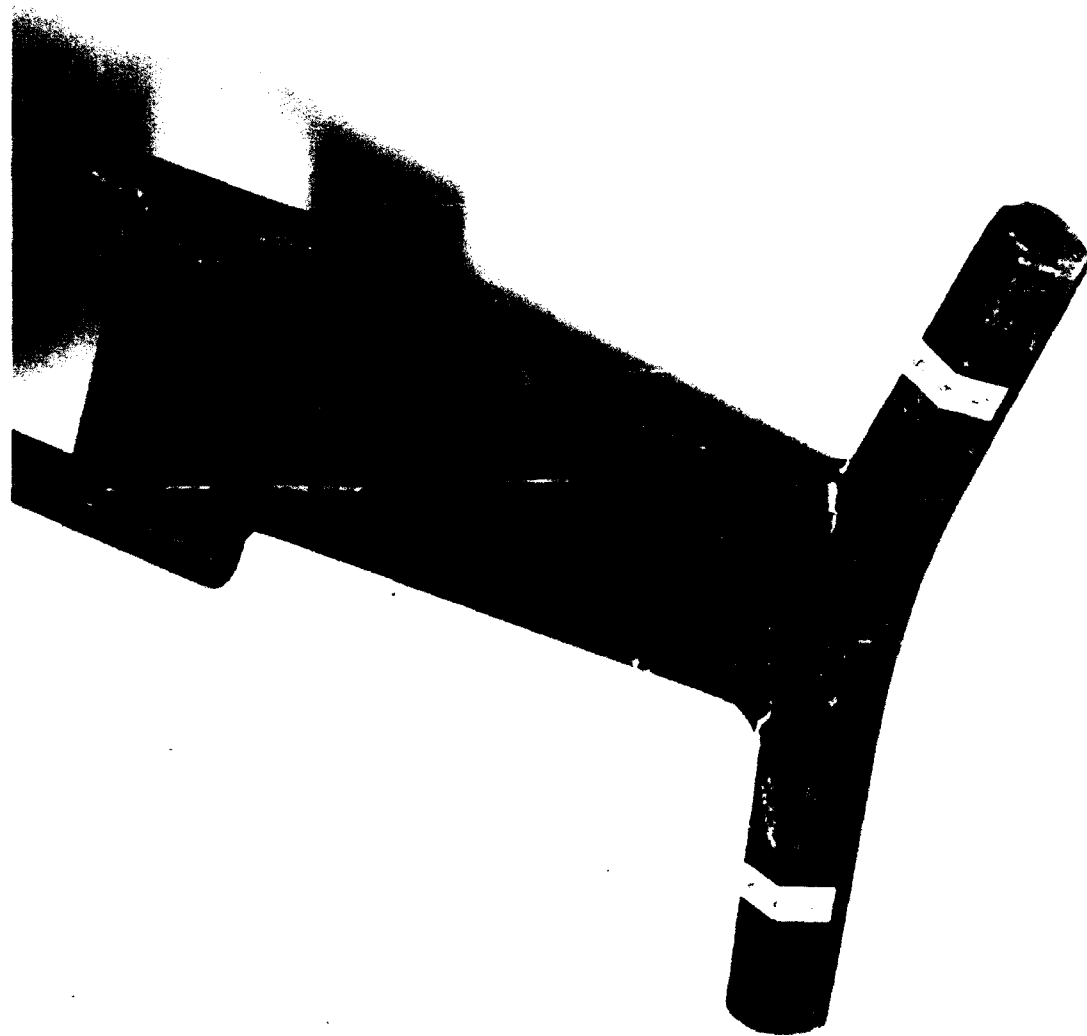




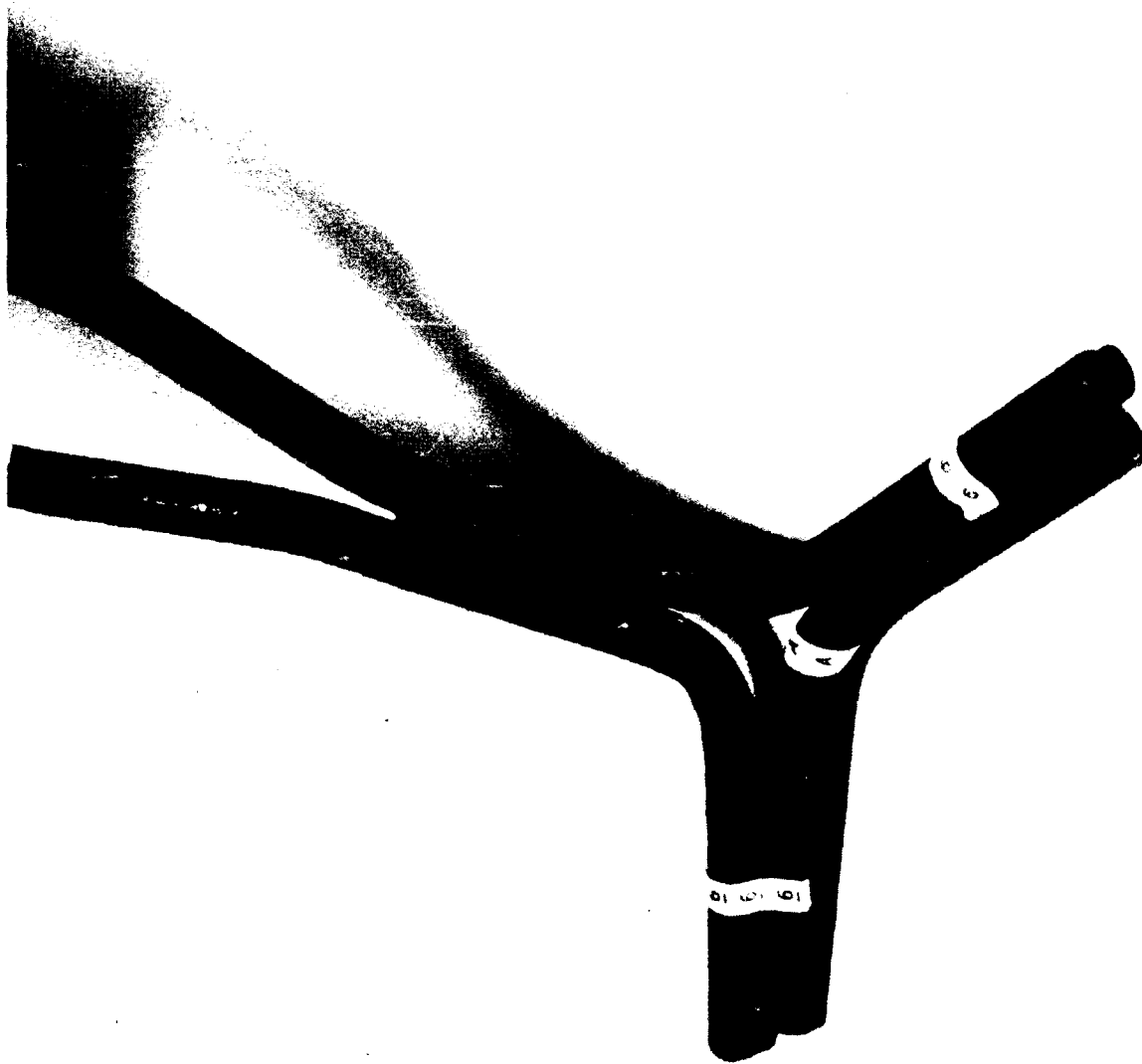
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
Photo No. AO317-SCN92-350-4735. Test sample No. 3. This sample failed at 3,735 pounds. Note the weld separation and bending in the "T" bar. The top ring also deformed.	



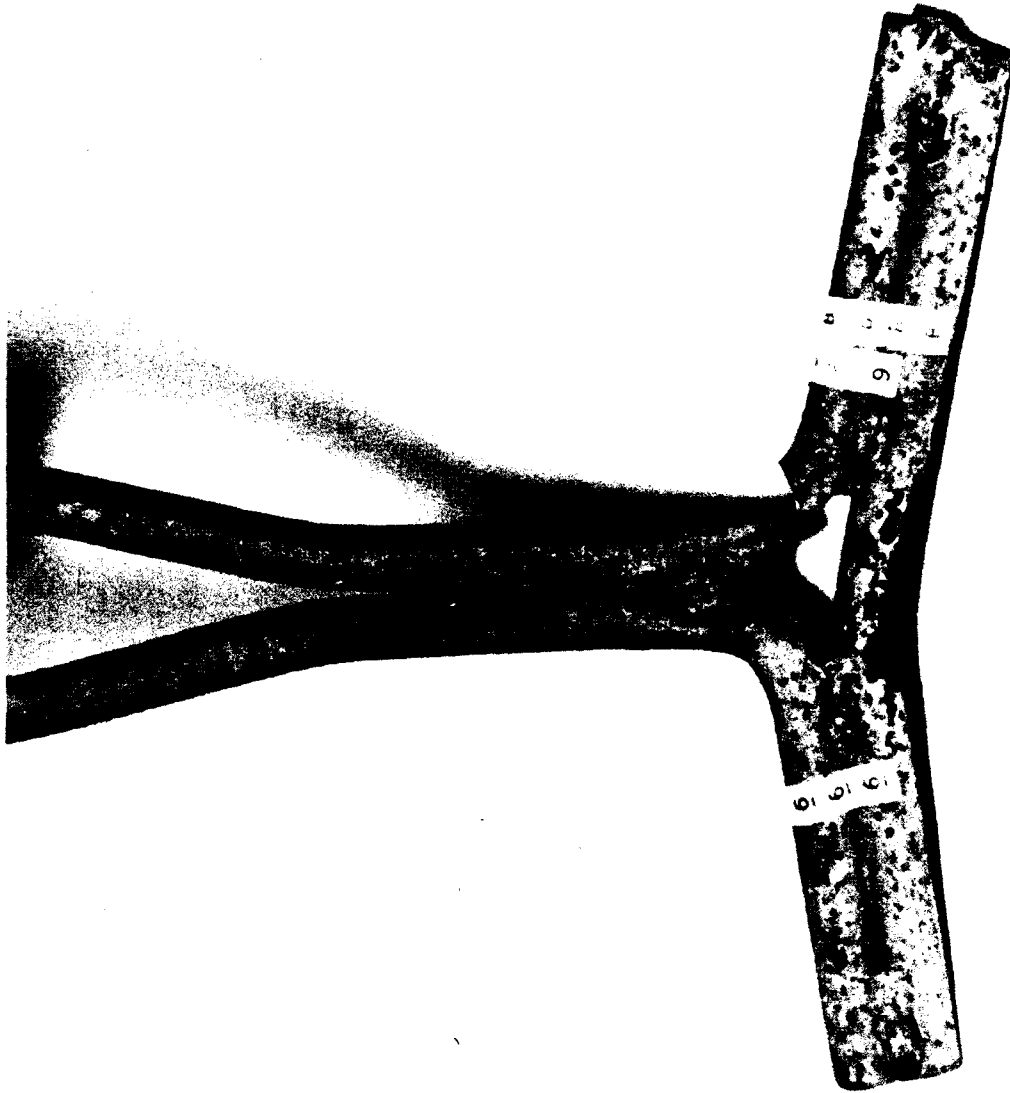
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
Photo No. AO317-SCN92-350-4736. Test sample No. 4. This sample failed at 7,200 pounds. In addition to breaking the "T" bar, the top ring also deformed.		



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
Photo No. AO317-SCN92-350-4737. Test sample No. 5. This sample failed at 7,860 pounds. In addition to weld separation of the "T" bar, the clip and banding loop also deformed.	

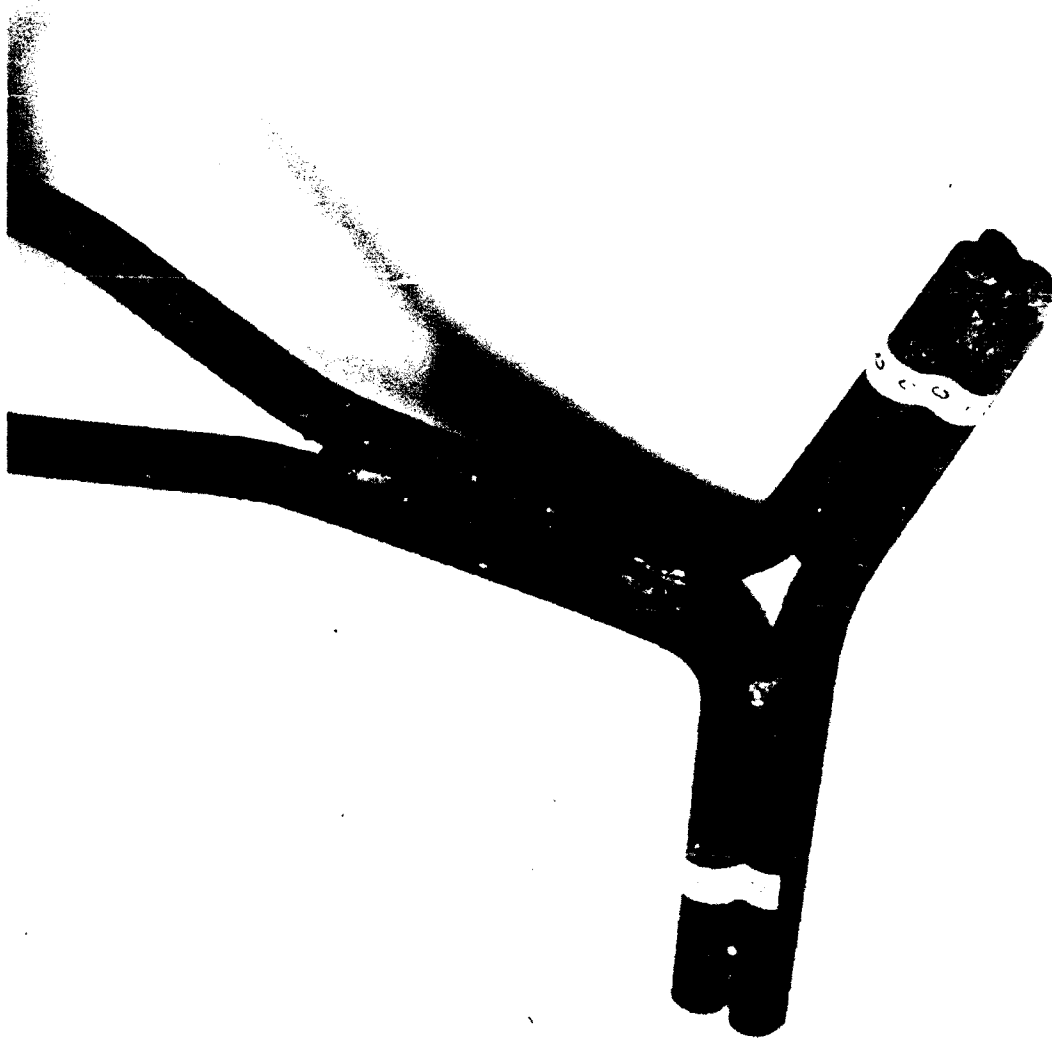


	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
Photo No. AO317-SCN92-350-4738. Test sample No. 6a. This tiedown sample failed at 3,735 pounds. Deformation was realized in the tie loop and the "T" base.	



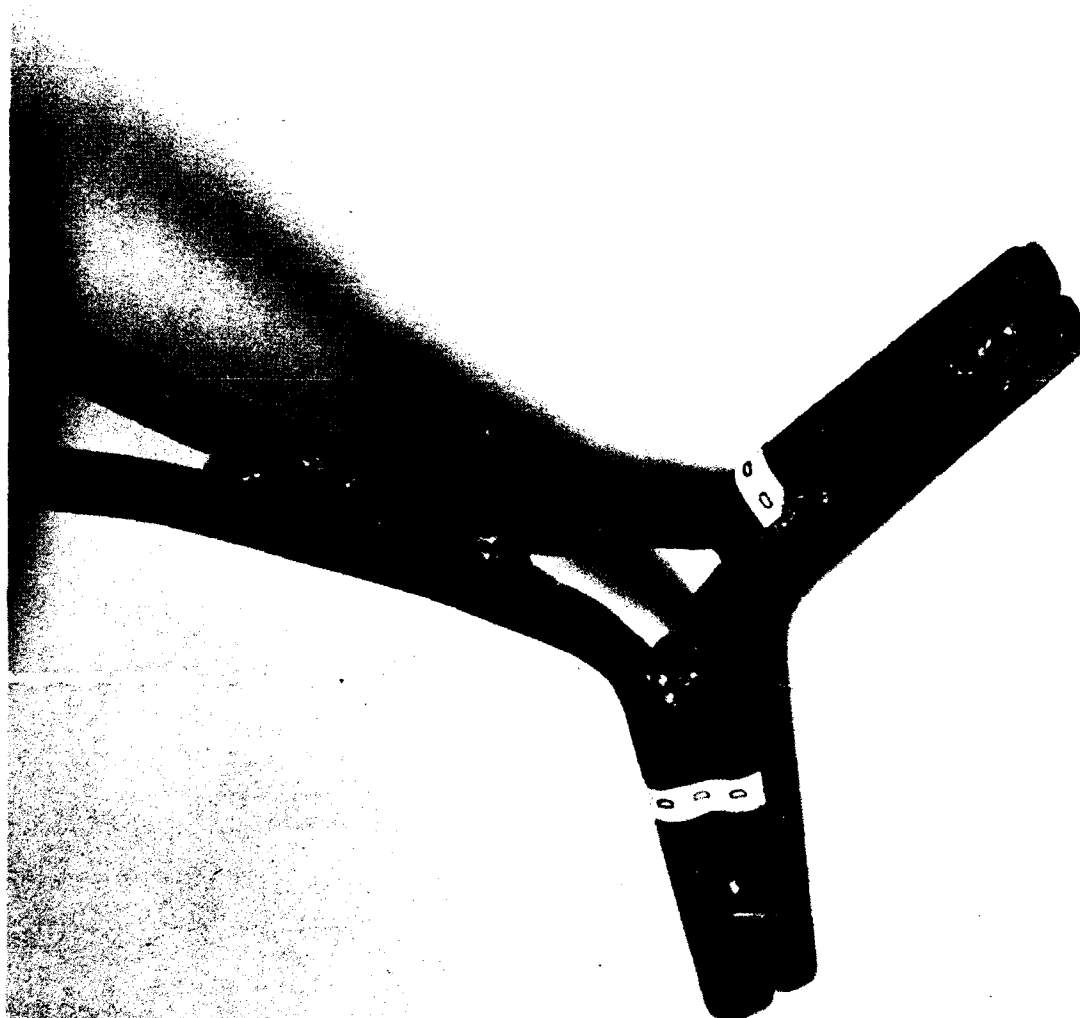
	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
Photo No. AO317-SCN92-350-4739. Test sample No. 6b. This tiedown sample failed at 7,582 pounds. Deformation occurred in the loop as well as in the mounting "T" base.		





	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
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Photo No. AO317-SCN92-350-4740. Test sample No. 6c. This tiedown sample failed at 3,100 pounds when a weld separated. The tie loop also deformed.
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	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL
Photo No. AO317-SCN92-350-4741. Test sample No. 6d. This sample deformed at 2,600 pounds. The welds finally broke at 7,080 pounds. The tie loop was also deformed to a point where it would not accept 2-inch banding.	